ANNUAL RESEARCH PROGRESS REPORT

(FY 2012)

GRAND FORKS HUMAN NUTRITION RESEARCH CENTER

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
NORTHERN PLAINS AREA

GRAND FORKS, NORTH DAKOTA 58203

HEALTHY BODY WEIGHT RESEARCH

MANAGEMENT UNIT

5450-010-00

Project Number: 5450-51000-047-00D **Accession:** 0419639 **FY:** 2012

ModeCode: 5450-10-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
HEALTHY BODY WEIGHT RESEARCH

NPL Leader: DAVID M KLURFELD **Prin Invs:** KATE J CLAYCOMBE

Start Date: 05/24/2010 **Term Date:** 09/30/2014

National Programs: 107 N Human Nutrition

Title: BIOLOGY OF OBESITY PREVENTION

Period Covered **From:** 10 / 2011 **To:** 9 / 2012 **Final Report?** No
Terminate in Two Months? No

Progress and Outcomes:

1a. Objectives (from AD-416):

It is not clear whether or how maternal nutrient status during pregnancy epigenetically affects mitochondrial energy metabolism in offspring to increase their susceptibility for developing obesity. Thus, the overall objective is to determine, using animal models, whether low protein intake, high energy intake, or low iron intake during pregnancy influence the development of obesity in offspring through the nutritional programming of mitochondrial function during early development. Specific objectives are: (1) determine whether maternal energy and key nutrient intakes produce epigenetic changes in energy metabolism that contribute to obesity in the offspring, and (2) determine the functional effects of energy, key nutrient intakes and physical activity on obesity-related changes in the expression of genes and protein components of energy metabolism pathways. Within the context of these objectives, the goals of the research are: (1) determine whether protein restriction during pregnancy produces epigenetic changes that, by compromising physiological function, increase the susceptibility of offspring to obesity when fed energy-dense diets; (2) determine whether consumption of diets having excess energy during pregnancy produces long-term mitochondrial dysfunction in offspring that increases their susceptibility to obesity; (3) determine whether low maternal intakes of iron during pregnancy produce mitochondrial dysfunction related to increased susceptibility to obesity in the offspring; and (4) determine whether low maternal intakes of iron during pregnancy impairs mitochondrial adaptation to physical activity in offspring that decreases the effectiveness of physical activity in reducing body weight.

1b. Approach (from AD-416):

Three dietary models will be used with laboratory animals. (1) Female rats will be fed diets containing low or normal levels of protein throughout pregnancy. Immediately after birth, the rats fed low protein diets will be changed to normal protein diets. Half of the offspring born to dams fed low protein diet during pregnancy will be weaned to high fat diets and half will be weaned to normal fat diets. Offspring of dams fed normal protein diet during pregnancy will be treated identically. The offspring will remain on the postweaning diets for the remainder of the experiment. (2) Female rats will be fed high or normal fat diets 14 days prior to conception and throughout pregnancy and lactation. Half of the offspring born to dams fed high fat during pregnancy will be weaned to high fat diets and half will be weaned to normal fat diets. Offspring of dams fed normal fat during pregnancy will be treated identically. (3) Female rats will be fed low or normal iron diets 21 days prior to conception and throughout pregnancy and lactation. Half of the offspring born to dams fed low iron during pregnancy will be weaned to high

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fat diets and half will be weaned to normal fat diets. Offspring of dams fed normal iron during pregnancy will be treated identically. In a variation of the low/normal maternal iron model, the offspring will be maintained on either normal or high fat diets for 8 weeks. At the end of 8 weeks, all the offspring will be given normal fat diet and half will be subjected to exercise for 6 weeks. Offspring will be tested for epigenetic changes, changes in glycolytic and oxidative metabolism, muscle and liver mitochondrial function, and mitochondrial oxidative damage over a period of 6 to 36 weeks after being weaned to their postnatal diets. Epigenetic changes will be assessed by determining DNA methylation and the up- and/or down-regulation of differentially methylated genes will be confirmed by real-time PCR. Measurements of mitochondrial function will include respiration, respiratory complex activity and composition, and reactive oxygen production. Oxidative and glycolytic metabolism will be assessed by measuring the activity of key enzymes in the glycolytic and oxidative pathways. Mitochondria are a major source of reactive oxygen species. Assessment of the outcomes of mitochondrial dysfunction will extend to measurement of oxidative and nitrosative damage to mitochondrial proteins and DNA. For metabolic assessment, blood will be analyzed for glucose, triglyceride, insulin, leptin, and adiponectin concentrations. In addition to body weights, adiposity, lean tissue mass, and total body water components of body composition will be assessed by quantitative magnetic resonance.

2. **Milestones for FY2012:**

1. Complete analyses of F1 samples from maternal low protein and postnatal high energy diet studies
   Milestone Fully Met

2. Complete analyses of F1 samples from maternal high fat and postnatal high energy diet studies
   Milestone Substantially Met

3. Complete analyses for mitochondrial function and biosynthesis in F1 muscle and liver samples and begin analyses for epigenetic changes in F1 samples from maternal low iron studies
   Milestone Not Met
   Other (a reason for not meeting the Milestone other than the ones above)
   The study was not initiated due to retirement of the senior scientist involved in the study.
4. Initiate maternal low Fe diet and complete Exercise Component for F1
   Milestone Not Met
   Other (a reason for not meeting the Milestone other than the ones above)
   The study was not initiated due to retirement of the senior scientist involved in the study

3. **Progress Report:**

Objective 1.A. This study determines whether protein restriction during pregnancy produces epigenetic changes that result in obesity in offspring.

The project team conducted studies to investigate how prenatal low protein and postnatal high fat diets influence obesity, adipose tissue growth, insulin like growth factor 2 (IGF2) gene expression, and energy utilization resulting in obesity and increased risk for type 2 diabetes in rats. We demonstrated that prenatal low protein and postnatal high fat intake increase the rate of adipose tissue growth in offspring through alterations in adipocyte numbers and sizes, expression of the epigenetically imprinted IGF2 gene, and by affecting adipose tissue energy utilization. Data also demonstrated that these alterations might increase risk for type 2 diabetes development. This work is currently in review in the International Journal of Obesity.

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To determine the mechanisms underlying prenatal low protein and postnatal high fat diet-induced obesity and adipose tissue inflammation, we showed that adipose tissue immune cell numbers were increased with high fat and decreased with low protein diets. Data from the liver samples of low protein prenatal diet showed decreased expression of genes involved in energy production.

Taken together, our research provides important information regarding the optimal maternal nutrition for healthy fetal growth and postnatal development of offspring. All of these results were presented in a series of abstracts at an international scientific meeting (Experimental Biology, American Society for Nutrition, 2012).

Objective 1.B. This study extends our ongoing research by determining whether consumption of diets having excess energy as dietary fat during pregnancy produces long-term mitochondrial dysfunction in offspring that increases their susceptibility to obesity. We have initiated this study and it has a projected completion date of November 2012.

4. Accomplishments

01 Maternal undernutrition followed by a postnatal high fat diet exacerbates obesity and insulin resistance in Sprague Dawley rats. This investigation studied the mechanisms of how maternal undernutrition during pregnancy results in obesity in offspring, especially when challenged postnatally with a high fat diet. ARS scientists at Grand Forks, ND demonstrated that when offspring are challenged with the high fat diet after weaning, those who were exposed to maternal low protein diet had greater adipose tissue growth rate, insulin-like growth factor gene expression and reduced energy utilization in the adipose tissue. Combined with higher serum concentrations of inflammatory cytokines and increased insulin resistance in the same offspring, these findings provided new insight into how low maternal protein intake and postnatal high fat diet promote obesity and insulin resistance into future generations.

107 3 A 2009

107 4 B 2009

02 Maternal low protein combined with a postnatal high fat diet results in increased adipose tissue inflammation and insulin resistance by increased adipose tissue inflammatory immune cell numbers. ARS scientists at Grand Forks, ND showed that adipose tissue resident macrophage numbers are increased with high fat feeding regardless of protein content of the prenatal diet. We also found that inflammatory subtype macrophage numbers are decreased in offspring when the dam consumes a low protein prenatal diet. These findings demonstrate how prenatal and postnatal nutritic can affect localization of inflammatory immune cells within adipose tissue and promot adipose tissue inflammation.

107 3 A 2009

107 3 B 2009

03 Maternal low protein combined with a postnatal high fat diet results in decreased birth weight due to increased energy expenditure in the brown adipose tissue. ARS scientists at Grand Forks, ND assessed the expression of genes involved in energy utilization in the brown adipose tissue from neonates. A maternal low protein diet wa associated with reduced birth weight and increased expression of energy utilization genes in the brown adipose tissue. These findings help elucidate the mechanism by which prenatal protein restriction increases the risk for low birth weight through increased energy expenditure in the offspring.

107 3 A 2009

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107 3 B 2009

04 Maternal low protein and postnatal high fat diets induce obesity by causing epigeneti changes in the offspring's muscle and liver tissues. ARS scientists at Grand Forks, ND measured expression of genes that are involved in mitochondrial biogenesis and thermogenesis. Our results showed that the offspring fed a low protein prenatal diet had decreased expression of hepatic and muscle genes that are involved in mitochondrial biogenesis and thermogenesis. Our preliminary data indicate that other genes that are regulated epigenetically such as igf2/H19 locus are differentially methylated due to prenatal low protein and postnatal high fat diets. These findings help understanding how the prenatal maternal diet programs metabolically active tissues in the body to adapt and increase the risk for obesity development when offspring are challenged by high fat diet after weaning.

107 3 A 2009
107 3 B 2009

5. Significant Activities that Support Special Target Populations:

6. Technology Transfer:

0 **Number of New CRADAs**
0 **Number of Active CRADAs**
0 **Number of New MTAs (providing only)**
0 **Number of Invention Disclosures Submitted**
0 **Number of Patent Applications Filed**
0 **Number of New Germplasm Releases**
0 **Number of new commercial licenses granted**
0 **Number of web sites managed**
0 **Number of non-peer reviewed presentations and proceedings**
0 **Number of newspaper articles and other presentations for non-science audiences**
5 **Number of Other Technology**

Other Technology Details:

01 **Description:** Invited oral presentation at international scientific meeting organized by the American Society for Pharmacology and Experimental Therapeutics. Perivascular fat: Pharmacology, physiology and function symposium 'Emerging fields of study on the adipose tissue', Experimental Biology 2012, San Diego, CA.
Transfer: scientific knowledge about perivascular adipose tissue and blood pressure
Customer/user: other scientists/researchers, graduate students, postdocs, clinicians and dietitians
Impact/outcome: sharing of information related to key roles perivascular adipose tissue plays in regulation of blood pressure

02 **Description:** Invited oral presentation at international scientific meeting organized by the American Society for Nutrition. Maternal programming of gene expression minisymposium 'Maternal low protein diet and postnatal high fat diet increases adipose imprinted gene expression', Experimental Biology 2012, San Diego, CA.
Transfer: scientific knowledge about effects of maternal and postnatal diet on obesity, adipose tissue growth, IGF2 gene expression, and

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insulin resistance
Customer/user: other scientists/researchers, graduate students, postdocs, clinicians and dietitians
Impact/outcome: sharing of information related to maternal low protein and postnatal high fat on altered adipose tissue growth rate, growth factor gene expression, adipose tissue cellularity, systemic inflammation, and increased insulin resistance in offspring

03 **Description:** Invited oral presentation at international scientific meeting organized by the American Society for Nutrition. Maternal programming of gene expression minisymposium 'Low dietary protein intake during pregnancy differentially affects mitochondrial copy number in stromal vascular cells from subcutaneous versus visceral adipose tissue in the offspring', Experimental Biology 2012, San Diego, CA.
Transfer: scientific knowledge about adipose tissue mitochondrial energy utilization that can be affected by maternal low protein and post natal high fat diet resulting in obesity
Customer/user: other scientists/researchers, graduate students, postdocs, clinicians and dietitians
Impact/outcome: sharing of information related to adipose tissue cellularity due to alterations in number of adipose tissue mitochondria and energy utilization capacity resulting in obesity

04 **Description:** Poster presentation at international scientific meeting organized by the American Society for Nutrition. 'Effects of pre- and postnatal diets on body compositions of diet-induced obesity prone Sprague-Dawley rats', Experimental Biology 2012, San Diego, CA.
Transfer: scientific knowledge about adipose tissue, lean body, and body weight changes due to pre- and postnatal diets
Customer/user: other scientists/researchers, graduate students, postdocs, clinicians and dietitians
Impact/outcome: sharing of information related to rate of adipose tissue and lean body growth during postnatal high fat diet and comparing effects of low and normal protein prenatal diets.

05 **Description:** Oral presentation at academic institution organized by the foundations biomedical science seminar hosted by University of North Dakota School of Medicine. 'Origin of Obesity: maternal Diet, Epigenetics, and Adipose Tissue, Grand Forks, ND.
Transfer: scientific knowledge about maternal diet and epigenetic programming
Customer/user: other scientists/researchers, graduate students, medical students, postdocs, and clinicians
Impact/outcome: sharing of information related to effects of maternal diet on epigenetic changes in adipose tissue leading to obesity and insulin resistance.

7. International Cooperation / Collaboration

01 CHINA
Collaborated with faculty from the Third Military Medical University at Chongqing, China and published a scientific paper about additive anti-inflammatory effects of flavonoids from tart cherry and statin.

Scientific Publications: **Log 115**

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1. Brown-Borg, H.M., Johnson, W.T., Rakoczy, S.G. 2012. Expression of oxidative phosphorylation components in mitochondria of long-living Ames dwarf mice. Age. 34:43-57. 000025859

2. Song, M., Schuschke, D.A., Zhou, Z., Chen, T., Wang, R., Johnson, W.T., Mcclain, C.J. 2012. High fructose feeding induces copper deficiency in Sprague-Dawley rats: A novel mechanism for obesity related fatty liver. Hepatology. 56:433-440. 000026114

3. Kalupahana, N.S., Moustaid-Moussa, N., Claycombe, K.J. 2012. Immunity as a link between obesity and insulin resistance. Molecular Aspects of Medicine . 33:26-34. 000027441

4. Zhou, Z., Nair, M.G., Claycombe, K.J. 2012. Synergistic inhibition of interleukin-6 production in adipose stem cells by tart cherry anthocyanins and atorvastatin. Phytomedicine. 19(2012)878-881. 000027907

5. Hsueh, H.W., Zhou, Z., Whelan, J., Allen, K.G., Kim, H., Claycombe, K.J. 2011. Stearidonic and eicosapentaenoic acids inhibit interleukin-6 (IL-6) expression in 1 mouse adipose stem cells via Toll-like receptor-2 (TLR2) mediated pathway. Journal of Nutrition. 141:1260-1266. 000026114

6. Kaluphahana, N.S., Claycombe, K.J., Moustaid-Moussa, N. 2011. (n-3) Fatty acids alleviate adipose tissue inflammation and insulin resistance: Mechanistic insights. Advances in Nutrition. 2:304-316. 000026816

7. Combs, G.F., Watts, J.J., Jackson, M.I., Johnson, L.K., Zeng, H., Scheett, A.J., Uthus, E.O., Schomburg, L., Hoeg, A., Hoefig, C.S., Davis, C.D., Milner, J.A. 2011. Determinants of selenium status in healthy adults. Nutrition Journal. doi:10.1186/1475-2891-10-75. 000025985

8. Uthus, E.O., Picklo, M.J. 2011. Obesity reduces methionine sulfoxide reductase activity in visceral adipose tissue. Free Radical Research. 45(9):1052-1060. 000026427

9. Siriwardhana, N., Kalupahana, N., Fletcher, S., Claycombe, K.J., Quignard-Boulange, A., Xin, W., Zhao, L., Moustaid-Moussa, N. 2012. N-3 and n-6 polyunsaturated fatty acids differentially regulate adipose angiotensinogen and other inflammatory adipokines in part via NF-kB dependent mechanisms. Journal of Nutritional Biochemistry. 23:1661-1667. 000027156

Approved: MCGUIRE MICHAEL R **Date:** 09/27/2012

Project Number: 5450-51000-047-01G **Accession:** 0422778 **FY:** 2012

ModeCode: 5450-10-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
HEALTHY BODY WEIGHT RESEARCH

NPL Leader: DAVID M KLURFELD **Prin Invs:** KATE J CLAYCOMBE

Start Date: 04/01/2012 **Term Date:** 03/31/2013

National Programs: 107 N Human Nutrition

Title: EXPERIMENTAL BIOLOGY 2012 SYMPOSIUM: ADIPOSE DYSFUNCTION INTERACTION OF ROS AND INFLAMMATION

Period Covered **From:** 10/2011 **To:** 9 /2012 **Final Report?** No
Terminate in Two Months? No

Agreement Number: 59-5450-2-0302

Organization Name: AMERICAN SOC FOR NUTRITION

Progress and Outcomes:

1a. Objectives (from AD-416):

The major purpose of this symposium is to enhance the visibility of the importance of research conducted at ARS by 1) fostering ARS objectives of providing a forum for the cutting edge reasearch presented by prominent scientists and to have symposium participants meet, network and exchange ideas with other leading investigators in their field, and 2) by showcasing the USDA Agricultural Research Service (ARS) strategic goal "No. 5.2.2: Define the role of nutrients, foods, and dietary patterns in growth, maintenance of health, and prevention of obesity and other chronic diseases".

The goal of this symposium is to provide a forum for the discussion of how oxidant signaling is altered in adipose tissue as a result of obesity. Recent data indicate that adipose dysfunction in obesity involves interactions between inflammatory pathways and reactive oxygen signaling. While numerous studies indicate that oxidant stress is elevated overall in the body as a result of obesity, there is now only a growing literature detailing the role of oxidant stress and oxidant stress signaling pathways in the regulation and dysfunction of adipose tissue itself. However, there is an incomplete understanding of the relationships of the cell types comprising adipose, their interplay in obesity, and the role oxidant stress that influences these relationships. Furthermore, the inflammatory processes present in obese adipose tissue modulates cellular oxidant stress and responses to oxidant stress. The speakers chosen to present data and to discuss this topic are highly-regarded and have made seminal contributions to the understanding of this area.

1b. Approach (from AD-416):

Two ARS scientists and one cooperator will serve as organizing co-chairs of this symposium. Four invited speakers, who will each present 30 minute oral talks, are highly-regarded and have made seminal contributions to the understanding of this area.

3. Progress Report:

This report documents research conducted under a Project Grant Agreement between ARS and the AMERICAN SOCIETY FOR NUTRITION. Additional details for the research can be found in the report for the parent project 5450-51000-047-00D, BIOLOGY OF OBESITY PREVENTION

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This report includes accomplishments resulting from a Project Grant Agreement between USDA-ARS and the American Society for Nutrition (ASN). The symposium was held at the 2012 Annual Experimental Biology meeting and was attended by over 400 national and international scientists, graduate students, postdocs, and ARS scientists. The symposium summary was written by the organizing co-chairs for a publication in the Journal of Advances in Nutrition (May 2012).

ARS PI monitoring activities to evaluate research progress included: phone calls/conference calls, email communications, discussions at professional conferences/meetings, review of Accomplishment Report.

Approved: CHANDLER LAURENCE D **Date:** 09/24/2012

Project Number: 5450-51000-049-00D **Accession:** 0421265 **FY:** 2012

ModeCode: 5450-10-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
HEALTHY BODY WEIGHT RESEARCH

NPL Leader: JOHN W FINLEY **Prin Invs:** LEAH D WHIGHAM GRENDELL

Start Date: 04/21/2011 **Term Date:** 09/30/2014

National Programs: 107 N Human Nutrition

Title: DIETARY GUIDELINES ADHERENCE AND HEALTHY BODY WEIGHT MAINTENANCE

Period Covered **From:** 10 / 2011 **To:** 9 / 2012 **Final Report?** No
Terminate in Two Months? No

Progress and Outcomes:

1a. Objectives (from AD-416):

Objective 1: Develop and validate assessments of behavioral factors that influence energy intake by a) development and validation of a satiety index of foods that reflects interactions of food with physical activity, body mass index, gender, and age; and b) determination of the effect of exercise on energy intake and eating rate.

Objective 2: Develop methods for assessing patterns of energy expenditure that include a) validation of breath markers as indicators of energy substrate utilization and; b) characterization of seasonal patterns of energy expenditure and balance in free-living individuals using novel applications of existing technologies (e.g., GPS, accelerometry, heart rate monitoring, doubly labeled water).

1b. Approach (from AD-416):

To complete the objectives of this proposal, we will conduct a series of studies with human volunteers. For Objective 1, we will model the satiating effects of selected individual food items and mixed meals. Our model will include the comparisons of hormonal and metabolic responses to food consumption to subjective satiety responses and subsequent energy intake, which we will evaluate in a repeated measures design human trial.
In Objective 2a, we will conduct controlled feeding studies to determine the effects of caloric restriction and exercise on breath markers of substrate utilization. In Objective 2b, we will identify seasonal changes in body fat, as well as where, how much, and when physical activity and dietary intake vary seasonally.

2. Milestones for FY2012:

1. Protocol refinement, IRB approval; Recruitment and initial experimental human studies.
   Milestone Substantially Met

2. Objective 1b. Removed
   Milestone Not Met
   Other (a reason for not meeting the Milestone other than the ones above)
   Replaced with Objective 3
3. Objective 2a. Develop and refine the protocol and obtain IRB approval; commence recruitment and initial experimental human studies.
   Milestone Fully Met

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4. Objective 2b. Write Manual of Procedures; Complete IRB application; Obtain IRB approval; Enroll 37 subjects
Milestone Fully Met

3. **Progress Report:**
Objective 1a. Remodeling of laboratory space for use for this objective was completed in June 2012. IRB application was submitted in January 2012. IRB approval was received and volunteer recruitment began in June 2012.
Objective 1b. Removed and replaced with Objective 3.
Objective 2a. Data collection from experimental human studies was completed for Experiment 2. Data analysis is underway, which is informing detailed protocol development for Experiment 1.
Objective 2b. IRB approval was received in June 2012. Recruitment for year one is complete and data collection began in July 2012.

This project includes an examination of the role of Atlantic salmon consumption as a source of omega-3 fatty acids for humans. This project is a collaboration with the ARS-National Cold Water Aquaculture Center, Franklin, ME. We demonstrated that baking salmon decreases the presence of fatty acid oxidation products without decreasing the content of beneficial omega-3 fatty acids in salmon. We have submitted one paper demonstrating that eating baked salmon increases blood omega-3 fatty acids in a dose-dependent manner and these data were presented at the 2012 Experimental Biology meeting.

This project includes an examination of the role of community-based lifestyle intervention in weight loss and improvements in body composition, fitness, and chronic disease risk biomarkers. The manuscript of results is currently being prepared and these data were presented at the 2012 Experimental Biology meeting.

This project includes a validation study of the use of resonance Raman spectroscopy for measuring skin carotenoid levels as a non-invasive tool to assess fruit & vegetable (F&V) intake (blood carotenoid levels are the current standard biomarker for F&V intake). This project is a collaboration with investigators at Yale University and the University of Utah. Data collection for half of the volunteers is completed; the 2nd half of the volunteers completed the study in August 2012. One abstract has been published (and presented as an oral abstract at the annual Experimental Biology meeting.

This project includes a description of barriers and facilitators to following the dietary guidelines reported by 5th grade American Indian children and parents. This is a collaboration with investigators at Candeska Chikina Community College. Data collection is complete. One abstract has been published and presented as an oral abstract at the annual Experimental Biology meeting.

4. **Accomplishments**

01 Baking reduces prostaglandin, resolvin, and hydroxy-fatty acid content of farm-raised Atlantic salmon (Salmo salar). Consumption of omega-3 polyunsaturated fatty acid (PUFA) rich fish is associated with a decreased risk of cardiovascular disease. It is unknown whether consumption of cooked omega-3 rich fish causes appreciable intake of lipid oxidation products or the nature of particular oxidation products. In this project we demonstrated that baking salmon decreases the presence of fatty acid oxidation products and does not decrease the content of beneficial omega-3 fatty acid in salmon. This work has impact for consumers, health professionals, and for producer

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of farmed salmon.

107 2 A 2009

02 Skin carotenoid concentration reflects response to a fruit/vegetable intervention study. Blood levels of carotenoids are considered the best biomarker of consumption of fruit and vegetable (FV) intake by humans. However, blood collection is invasive and reflects short-term intake. Skin carotenoid detection is a promising new method of non-invasively measuring effectiveness of FV-promoting interventions. In this controlled feeding study, we showed that skin carotenoid levels respond significantly to both increased and decreased levels of FV in the diet. This work, which is nearir completion of data collection, has impact for researchers, public health practitioner and policy makers.

107 2 A 2009

5. Significant Activities that Support Special Target Populations:

6. Technology Transfer:

0 **Number of New CRADAs**
0 **Number of Active CRADAs**
1 **Number of New MTAs (providing only)**
0 **Number of Invention Disclosures Submitted**
0 **Number of Patent Applications Filed**
0 **Number of New Germplasm Releases**
0 **Number of new commercial licenses granted**
0 **Number of web sites managed**
0 **Number of non-peer reviewed presentations and proceedings**
0 **Number of newspaper articles and other presentations for non-science audiences**
31 **Number of Other Technology**

New MTA (providing only) Details:

01 **MTA ID:** 9004
Saliva samples

Technology:Human saliva samples to be used for SNP analysis related to vitamin A and lipid pathways that affect the carotenoid uptake and conversion efficency.
Customer/User: University of Newcastle - United Kingdom
Impact/Outcome: No known impact at this time

Other Technology Details:

01 **Description:** Side by Side: Hunger and Obesity (L Whigham)
Transfer: Invited presentation at Taking Action to End Hunger Summit, Fargo, ND (September 2011)
Customer/user: City, State, and Regional staff and administrators of Agriculture Departments, food banks, and food distributors
Impact/outcome: Provided a scientific overview of obesity and food insecurity

02 **Description:** Dermal carotenoids as measured by resonance Raman spectroscopy as a

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biomarker of response to a fruit/vegetable intervention study (L Jahns and L Whigham)
Transfer: oral abstract presentation for International society meeting Experimental Biology, San Diego, CA (April 2012)
Customer/user: scientists, health professionals, nutritionists
Impact/outcome: Sharing of GFHNRC research outcomes. First to demonstrate that dermal carotenoids measured by resonance Raman spectroscopy reflect changes in vegetable and fruit intake in a controlled feeding study.

03 **Description:** Understanding American-Indian children's perceived barriers and facilitators to following the Dietary Guidelines for Americans (DGA) (L Jahns).
Transfer: Oral abstract presentation for International society meeting Experimental Biology, San Diego, CA (April 2012)
Customer/user: scientists, health professionals, nutritionists
Impact/outcome: Sharing of GFHNRC research outcomes. First to Identify and describe barriers and facilitators to following the dietary guidelines experienced by 5th graders living on a rural reservation.

04 **Description:** Feeding practices correlated with authoritative parenting style and responsive feeding style scores (L Jahns)
Transfer: presentation for International society meeting Experimental Biology, San Diego, CA (April 2012)
Customer/user: scientists, health professionals, nutritionists
Impact/outcome: Sharing of GFHNRC research outcomes. Describe aspects of resilience to obesity in families with preschool children.

05 **Description:** Twice-weekly consumption of farmed Atlantic salmon increases plasma content of phospholipid n-3 fatty acids (S Raatz)
Transfer: presentation for International society meeting Experimental Biology, San Diego, CA (April 2012)
Customer/user: scientists, health professionals, nutritionists
Impact/outcome: Demonstrated that twice weekly consumption of farmed Atlantic Salmon enhanced plasma phospholipid fatty acid content in a dose responsive manner.

06 **Description:** The effect of dietary fat and omega-3 fatty acids on whole body lipid oxidation(S Raatz)
Transfer: presentation for International society meeting Experimental Biology, San Diego, CA (April 2012)
Customer/user: scientists, health professionals, nutritionists
Impact/outcome: Demonstrated that the consumption of a high omega-3 diet leads to increased production of in vivo secondary lipid peroxidation products.

07 **Description:** Community based lifestyle modification improves body weight, anthropometric, and fitness parameters (S Raatz)
Transfer: presentation for International society meeting Experimental Biology, San Diego, CA (April 2012)
Customer/user: scientists, health professionals, nutritionists

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Impact/outcome: Demonstrated that a community-based lifestyle intervention performed by a fitness trainer and registered dietitian is an appropriate format for weight management resulting in weight loss, improved functional fitness, and improvements in chronic disease risk biomarkers for up to 20 weeks after an 8-week group intervention.

08 **Description:** Metabolic and Cardiovascular Adjustments during Psychological Stress and Carotid Artery Intima-Media Thickness in Youth (JN Roemmich)
Transfer: presentation for International society meeting Society for Behavioral Medicine, New Orleans, LA (April 2012)
Customer/user: scientists, health professionals, nutritionists
Impact/outcome: First to demonstrate that cardiovascular responses to psychological stress are in excess of what would be expected based on metabolic demand in youth, and that traditionally measured SBP and SBP over the expected based on metabolic demand were associated with greater carotid artery intima media thickness, a marker of atherogenesis.

09 **Description:** What can child silhouette data tell us? Exploring links to parenting, food and activity behaviors, BMI, and maternal concerns (L Jahns)
Transfer: presentation for International society meeting International Society for Behavioral Nutrition and Physical Activity, (May 2012)
Customer/user: scientists, health professionals, nutritionists
Impact/outcome: Sharing of GFHNRC research outcomes. Describe aspects of resilience to obesity in families with preschool children.

10 **Description:** Parent weight change predicts child weight change in family-based weight control for pre-school children conducted in the primary care setting (Buffalo Healthy Tots) (JN Roemmich)
Transfer: presentation for International society meeting Society For Pediatric Research, Boston, MA (May 2012)
Customer/user: scientists, health professionals, nutritionists
Impact/outcome: First to translate and demonstrate efficacy of a family-based obesity weight loss program from a specialized university setting to a field pediatrician practice setting.

11 **Description:** Association of park access with usual stress of adolescents (JN Roemmich)
Transfer: presentation for International society meeting American College of Sports Medicine, San Francisco, CA (June 2012)
Customer/user: scientists, health professionals, nutritionists
Impact/outcome: Demonstrated a protective effect of parks on daily stress in that children who lived in neighborhoods with greater green space and park area reported lower daily stress levels.

12 **Description:** Habituation and Alterations in Perceived Stress Predict BMI Percentile Changes Across a School Year (JN Roemmich)
Transfer: presentation for International society meeting American College of Sports Medicine, San Francisco, CA (June 2012)
Customer/user: scientists, health professionals, nutritionists
Impact/outcome: First to demonstrate that children who had greater

increases in daily stress during a school day and those who habituated slowest to a cognitive stressor that modeled a school-related task had greater increases in BMI percentile across a school year.

13 **Description:** Interactive Effects of Stress Reactivity and Usual Stress on Adolescents Cardiovascular Health (JN Roemmich)
Transfer: presentation for International society meeting American College of Sports Medicine, San Francisco, CA (June 2012)
Customer/user: scientists, health professionals, nutritionists
Impact/outcome: first to demonstrate that children who incur the greatest daily stress and those that are the most stress reactive have a greater carotid artery intima media thickness, a measure of atherogenesis.

14 **Description:** Level of Autonomy on the Amount of Physical Activity in Young Children (JN Roemmich)
Transfer: presentation for International society meeting American College of Sports Medicine, San Francisco, CA (June 2012)
Customer/user: scientists, health professionals, nutritionists
Impact/outcome: Demonstrated that providing autonomy over activity choices in a natural setting increases young children's participation in physical activity.

15 **Description:** CLA in Obesity (L Whigham)
Transfer: presentation for International society meeting Spencer Award Symposium, American Chemical Society (August 2012)
Customer/user: scientists, health professionals, nutritionists
Impact/outcome: Overview of the field and sharing of research outcomes.

16 **Description:** Dairy cattle mtDNA, guinea pig asthma, and the nutritional chemistry of obesity: a molecular path through research. (L Whigham)
Transfer: invited presentation, University of North Dakota Medical School Graduate Student Seminar Series (October 2011)
Customer/user: Graduate students and faculty at the University of North Dakota Medical School
Impact/outcome: Scientific overview and data presentation.

17 **Description:** The declining prevalence of overweight among Russian children: Income, diet, and physical activity behavior changes (L Jahns)Transfer: invited presentation, Transdisciplinary Childhood Obesity Prevention graduate program, South Dakota State University, Brookings, SD (October 2011)
Customer/user: Graduate students in the Transdisciplinary Childhood Obesity Prevention graduate program - SDSU and University of Nebraska, Lincoln.
Impact/outcome: Education on the effects of nutrition transition on overweight prevalence among Russian children.

18 **Description:** Healthy Body Weight Research Unit (JN Roemmich)
Transfer: Presentation of overview of Research Unit, and the expertise and ongoing research of Unit scientists at the United States Army Institute for Environmental Medicine, Natick, MA (January 2012)

Project Number: 5450-51000-049-00D **Accession:** 0421265 **FY:** 2012

Customer/user: Investigators, Nutritionists
Impact/outcome: Laid the groundwork for developing collaborations between USDA-ARS-GFHNRC and Department of Defense nutritional scientists. Visit led to a collaboration between Susan Raatz (Unit scientist) and Phil Karl (USARIEM scientist) to test the satiating effects of foods. Other collaborative efforts are in discussion.

19 **Description:** Can skin carotenoid levels be used to assess the effectiveness of fruit and vegetable interventions? (L Jahns)
Transfer: invited presentation, Interdepartmental Nutrition Program (INP) Seminar, Purdue University, West Lafayette, IN (February 2012)
Customer/user: faculty and students of Purdue University
Impact/outcome: Education on skin carotenoids as a potential biomarker of vegetable and fruit intake for faculty and graduate and undergraduate students.
Laid the groundwork for developing collaborations between USDA-ARS-GFHNRC and Purdue university nutritional scientists.

20 **Description:** Behavioral and Biological Pathways Between Stress and Health in Children (JN Roemmich)
Transfer: invited presentation, South Dakota State University's 29th Annual Health and Nutrition Conference, Brookings, SD (March 2012)
Customer/user: faculty and students in nutrition and dietetics programs in northern plains states
Impact/outcome: Education on stress and health for faculty and graduate and undergraduate students.

21 **Description:** Keynote address: Park Access, Park Amenities, Internal Motivation and the Physical Activity of Youth and Adults (JN Roemmich)
Transfer: invited presentation, Midwest Parks and Recreation Conference, Grand Forks, ND (April 2012)
Customer/user: City-, County- and State-level park administrators and Board members
Impact/outcome: Education on designing parks so that the amenities they provide can better compete with the motivating value of sedentary behaviors.

22 **Description:** Omega 3 Fatty Acids: Metabolism and Function (S Raatz)
Transfer: Medical Grand Rounds, ALTRU Health System, Grand Forks, ND (September 2012)
Customer/user: Medical staff of ALTRU Health System
Impact/outcome: Education of the use of water based emulsion of fish oil compared to other formulations (triglyceride, ethyl esters).

23 **Description:** Behavioral Approaches to Weight Control (JN Roemmich)
Transfer: Seminar presentation at Grand Forks Health & Wellness Fair, Grand Forks, ND (January 2012)
Customer/user: Public in Grand Forks, ND area
Impact/outcome: Promoted healthy lifestyle weight control behaviors that can promote weight control for a lifetime.

24 **Description:** Grand Forks Human Nutrition booth (L Jahns, S Raatz, J Roemmich, L Whigham)

Transfer: Demonstrations at 2012 Health Care Expo, Grand Forks, ND (January 2012)
Customer/user: Public in Grand Forks, ND area; over 2000 attendees
Impact/outcome: Promoted healthy nutrition guidelines for community, enhanced visibility of the GFHNRC, assisted with recruiting volunteers for nutrition studies.

25 **Description:** Are your sleeping habits affecting your waistline? (L Whigham)
Transfer: Article in Grand Forks Herald (January 2012)
Customer/user: Public in Greater Grand Forks
Impact/outcome: Educate and motivate the general public about the importance of adequate sleep and the relationship of sleep deprivation to obesity.

26 **Description:** Water: An Important Part of a Healthy Winter Diet (L Jahns)
Transfer: Article in Grand Forks Herald (March 2012)
Customer/user: Public in Greater Grand Forks
Impact/outcome: Nutrition information for the public

27 **Description:** "An Active and Healthy Life" (JN Roemmich)
Transfer: Article in Grand Forks Herald, Grand Forks, ND (April 2012)
Customer/user: Lay public of northeast North Dakota
Impact/outcome: Educate and motivate general public about the health benefits of physical activity and how to start an activity program.

28 **Description:** "Redesigning Activity Back Into Your Life" (JN Roemmich)
Transfer: Article in Grand Forks Herald, Grand Forks, ND (April 2012)
Customer/user: Lay public of northeast North Dakota
Impact/outcome: Educate and motivate general public about taking advantage of neighborhood environment facilities and rearranging their home and work environments to make it easier to make the choice to be physically active.

29 **Description:** Parks: Neighborhood Resources for Physical Activity (JN Roemmich)
Transfer: Invited presentation for the Optimist Club, Grand Forks, ND (May, 2012)
Customer/user: Optimist Club members of Grand Forks, ND
Impact/outcome: The Optimist Club supports a local park. Educated the Club on novel park designs based on the latest research to promote park visitation and physical activity.

30 **Description:** The Question of Sugar (S Raatz)
Transfer: Article in Grand Forks Herald (September 2012)
Customer/user: Public in Greater Grand Forks
Impact/outcome: Nutrition information for the public

31 **Description:** Study Design and Research Methods using Human Volunteers (L Whigham)
Transfer: Guest lecture, Methods in Pharmacology and Physiology (November 2011)
Customer/user: Graduate students, University of North Dakota Medical School
Impact/outcome: Taught graduate students principles of research methodology.

Project Number: 5450-51000-049-00D **Accession:** 0421265 **FY:** 2012

7. International Cooperation / Collaboration

01 UNITED KINGDOM
Name of international institution: Newcastle University
Objectives of the research: assessment of genotype as a determinant of carotenoid uptake and conversion efficiency among individuals.
How the work exchange takes place: Email, materials sent
Funding: ARS and Newcastle University

Scientific Publications: **Log 115**

1. Raatz, S.K., Young, L.R., Picklo, M.J., Sauter, E.R., Qin, W., Kurzer, M.S. 2012. Total dietary fat and fatty acid content modify plasma phospholipid fatty acids, desaturase activity indices and urinary prostaglandin E. Nutrition Research. 32:1-7. 000026964

2. Buchholz, A.C., Van Loan, M., Whigham Grendell, L.D., Lukaski, H. 2011. Lifestyle modification to promote weight loss in the absence of energy restriction. Journal of Nutrition and Metabolism. 2011:1-2. 000027752

3. Jahns, L.A., Adair, L., Mroz, T., Popkin, B.M. 2011. The declining prevalence of overweight among Russian children: income, diet, and physical activity behavior changes. Economics and Human Biology. 10 (2012) 139-146. 000024642

4. Chen, X., Jahns, L.A., Gittelsohn, J., Wang, Y. 2011. Who is missing the message? Targeting strategies to increase food label use among US adults. Public Health Nutrition. 15(5),760-772. 000026416

5. Raatz, S.K., Golovko, M.Y., Brose, S.A., Rosenberger, T.A., Burr, G.S., Wolters, W.R., Picklo, M.J. 2011. Baking reduces prostaglandin, resolvin, and hydroxy-fatty acid content of farm-raised Atlantic salmon (Salmo salar). Journal of Agricultural and Food Chemistry. 59:11278-11286. 000026965

6. Roemmich, J.N., Lambiase, M.J., Lobarinas, C.L., Balanteki, K.N. 2011. Interactive effects of dietary restraint and adiposity on stress-induced eating and the food choice of children. Eating Behaviors. 12:309-312. 000027546

7. Salvy, S., Bowker, J.C., Nitecki, L.A., Kluczynski, M.A., Germeroth, L.J., Roemmich, J.N. 2011. Effects of ostracism and social connection-related activities on adolescents' motivation to eat and energy intake. Journal of Pediatric Psychology. 37(1):23-32. 000027571

8. Epstein, L.H., Carr, K.A., Lin, H., Fletcher, K.D., Roemmich, J.N. 2012. Usual energy intake mediated the relationship between food reinforcement and BMI. Obesity. DOI:10.1038/oby.2012.2. 000027692

9. Barkley, J.E., Salvy, S., Roemmich, J.N. 2012. The effect of simulated ostracism on physical activity behavior in children. Pediatrics. 129(3):e659-666. 000027546

10. Feda, D.M., Lambiase, M.J., Mccarhty, T., Barkley, J.E., Roemmich, J.N. 2011. Effect of increasing the choice of active options on children's physical activity. Journal of Science and Medicine in Sports. 15:334-340. 000027547

11. Roemmich, J.N., Lambiase, M.J., Mccarthy, T.F., Feda, D.M., Kozlowski, K.F. 2012. Autonomy supportive environments and mastery as basic factors to motivate physical activity in children: a controlled laboratory study. International Journal of Behavioral Nutrition and Physical Activity. doi:10.1186/1479-5868-9-16. 000027699

12. Lambiase, M.J., Dorn, J., Roemmich, J.N. 2012. Metabolic and cardiovascular 000027399

Project Number: 5450-51000-049-00D **Accession:** 0421265 **FY:** 2012

adjustments during psychological stress and carotid artery intima-media thickness in youth. Physiology and Behavior. 105:1140-1147.

13. Balantekin, K.N., Roemmich, J.N. 2012. Children's coping after psychological stress: choices among food, physical activity, and television. Appetite. 59:298-304. 000028067

14. Lambiase, M.J., Dorn, J., Chernega, N.J., Mccarthy, T.F., Roemmich, J.N. 2012. Excess heart rate and systolic blood pressure during psychological stress in relation to metabolic demand in adolescents. Biological Psychology. 91:42-47. 000027393

15. Roemmich, J.N., Lombarinas, C.L., Barkley, J.E., White, T.M., Paluch, R., Epstei, L.H. 2012. Use of an open-loop system to earn television-time and increase physical activity. Pediatric Exercise Science. 24(3):384-398. 000027547

Approved: MCGUIRE MICHAEL R **Date:** 09/27/2012

Project Number: 5450-51000-049-02N **Accession:** 0412737 **FY:** 2012

ModeCode: 5450-10-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
HEALTHY BODY WEIGHT RESEARCH

NPL Leader: JOHN W FINLEY **Prin Invs:** GERALD F COMBS

Start Date: 01/01/2008 **Term Date:** 12/31/2012

National Programs: 107 N Human Nutrition

Title: GRAND FORKS COMMUNITY-BASED HEALTH AND FITNESS AGENDA

Period Covered **From:** 10/2011 **To:** 9 /2012 **Final Report?** Yes
Terminate in Two Months? No

Agreement Number: 58-5450-8-0101N

Organization Name: GRAND FORKS PARK DISTRICT

Progress and Outcomes:

1a. **Objectives (from AD-416):**

To develop a long-term partnership to foster the development of effective wellness/fitness programs in the Greater Grand Forks Community that will provide opportunities for community based research addressing issues related to the prevention of obesity.

1b. **Approach (from AD-416):**

The Grand Forks Parks District (GFPD) will work with community groups to develop wellness/fitness programs and facilities in the Greater Grand Forks Community. The Grand Forks Human Nutrition Research Center (GFHNRC) will work with the GFPD to advise on issues related to the health needs of citizens, and the design and implementation of those programs/facilities. Both institutions will work together to identify strategic linkages that will meet the goals of the GFPD and advance the research mission of the GFHNRC.

3. **Progress Report:**

This report documents research conducted under a Non Funded Cooperative Agreement between ARS and the GRAND FORKS PARK DISTRICT. Additional details for the research can be found in the report for the parent project 5450-51000-049-00D, DIETARY GUIDELINES ADHERENCE AND HEALTHY BODY WEIGHT MAINTENANCE

GFHNRC scientists worked with GFPD program planners to: a.) plan and equip for research use of an 850 sq. ft. suite at the new GFPD community fitness center. This suite, located prominently, will serve as the venue for recruiting volunteers for research studies, and for interviewing, evaluating and drawing blood samples from subjects participating in such studies conducted in the fitness center. b.) evaluated the fitness efficacies of exercise equipment being considered for use in the fitness center. c.) initiated a study of health-impacts of various modalities of use of GFPD outdoor parks by middle-schoolers.

ARS PI monitoring activities to evaluate research progress included: phone calls/conference calls, on-site Cooperator/ARS meetings, site visits, email communications, discussions at professional conferences/meetings, review of Accomplishment Report.

Project Number: 5450-51000-049-02N **Accession:** 0412737 **FY:** 2012

Approved: CHANDLER LAURENCE D **Date:** 11/07/2012

Project Number: 5450-51000-049-03N **Accession:** 0414947 **FY:** 2012

ModeCode: 5450-10-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
HEALTHY BODY WEIGHT RESEARCH

NPL Leader: JOHN W FINLEY **Prin Invs:** GERALD F COMBS

Start Date: 01/01/2009 **Term Date:** 12/31/2013

National Programs: 107 N Human Nutrition

Title: GREAT PLAINS HEALTH RESEARCH CONSORTIUM

Period Covered **From:** 10/2011 **To:** 9 /2012 **Final Report?** No
Terminate in Two Months? No

Agreement Number: 58-5450-9-0105N

Organization Name: UNIVERSITY NEBRASKA MED CNTR

Progress and Outcomes:

1a. **Objectives (from AD-416):**

The University of Nebraska Medical Center (UNMC) will bring together regional institutions with a common interest in rural and other health disparities to establish the Great Plains Health Research Consortium (GPHRC). The ARS-Grand Forks Human Nutrition Research Center will be one of the regional research institutions in this consortium.

1b. **Approach (from AD-416):**

The Great Plains Health Research Consortium will link those research institutions through scientist-to-scientist interactions facilitated by electronic collaboration technologies, and will seek to foster the development of collaborative research projects through the use of funds leveraging, technology/methodology sharing, and some seed funding.

3. **Progress Report:**

This report documents research conducted under a Non Funded Cooperative Agreement between ARS and the UNIVERSITY NEBRASKA MEDICAL CENTER. Additional details for the research can be found in the report for the parent project 5450-51000-049-00D, DIETARY GUIDELINES ADHERENCE AND HEALTHY BODY WEIGHT MAINTENANCE

This project provided medical oversight of human studies conducted at the GFHNRC. This oversight was provided in the form of direction of the GFHNRC Human Subjects Safety Monitoring Committee which was chaired by a UNMC physician and clinical investigator. The committee oversaw 4 GFHNRC human studies protocols through teleconferences, e-mails and discussions at professional meetings.

ARS PI monitoring activities to evaluate research progress included: phone calls/conference calls, email communications, discussions at professional conferences/meetings, review of Accomplishment Report.

Approved: MCGUIRE MICHAEL R **Date:** 09/18/2012

Project Number: 5450-51000-049-05N **Accession:** 0419844 **FY:** 2012

ModeCode: 5450-10-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
HEALTHY BODY WEIGHT RESEARCH

NPL Leader: JOHN W FINLEY **Prin Invs:** LISA A JAHNS

Start Date: 07/01/2010 **Term Date:** 09/30/2014

National Programs: 107 N Human Nutrition

Title: GREAT - GRAND FORKS SEASONALITY IN ENERGY BALANCE AND ACTIVE TRANSPORT PILOT STUDY

Period Covered **From:** 10 / 2011 **To:** 9 / 2012 **Final Report?** No
Terminate in Two Months? No

Agreement Number: 58-5450-0-0106N

Organization Name: UNIVERSITY OF CALIFORNIA

Progress and Outcomes:

1a. **Objectives (from AD-416):**

The overall objective of this project is to identify effective ways to facilitate and promote behavior change in individuals and groups to meet dietary and physical activity recommendations for health.

1b. **Approach (from AD-416):**

We will employ novel field methods and laboratory methods (assessment of energy expenditure by the metabolism of doubly-labeled water, energy substrate assessment by breath carbon isotope ratio, and body composition analysis by DXA) for objective assessment of total energy expenditure, physical activity energy expenditure, and energy intake in free-living individuals. We will link these data to environmental factors (such as season and weather), and to socio-demographic, biological, and psychosocial predictors of energy balance. This study will provide the basis for family-based interventions addressing the identified needs of targeted individuals for maintenance of healthy body weight. The primary outcome measure will be change in weight over time. We propose to build a robust model that can be used to inform family based interventions by including groups of potentially modifying covariates such as age, gender, race/ethnic group, SES, mood, weather, active transport patterns, chronotype, and location. The significance of seasonality will be tested, along with interactions by internal and external factors. Because of the complexity involved in combining data from multiple sources, state-of-the-science tools are needed for data processing, visualization, and analysis. We propose to cooperate with UCSD-EPARC who will provide remote training and support to the GFHNRC team throughout the study period and provide PALMS (Physical Activity Location Measurement System) software.

3. **Progress Report:**

This report documents research conducted under a Non Funded Cooperative Agreement between ARS and the UNIVERSITY OF CALIFORNIA. Additional details for the research can be found in the report for the parent project 5450-51000-049-00D, DIETARY GUIDELINES ADHERENCE AND HEALTHY BODY WEIGHT MAINTENANCE

IRB approval was received in June 2012. Twenty-seven participants were recruited into the study and data collection began in July 2012.

Project Number: 5450-51000-049-05N **Accession:** 0419844 **FY:** 2012

ARS PI monitoring activities to evaluate research progress included: phone calls/conference calls, discussions at professional conferences/meetings, review of Accomplishment Report.

Approved: MCGUIRE MICHAEL R **Date:** 09/18/2012

Project Number: 5450-51000-049-09S **Accession:** 0421842 **FY:** 2012

ModeCode: 5450-10-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
HEALTHY BODY WEIGHT RESEARCH

NPL Leader: JOHN W FINLEY **Prin Invs:** SUSAN K RAATZ

Start Date: 08/01/2011 **Term Date:** 07/31/2013

National Programs: 107 N Human Nutrition

Title: EVALUATE THE NUTRITIONAL ADEQUACY AND EFFECTS OF DIETARY FATS AND LIPIDS

Period Covered From: 10/2011 **To:** 9 /2012 **Final Report?** No
Terminate in Two Months? No

Agreement Number: 58-5450-1-0341

Organization Name: UNIVERSITY OF NORTH DAKOTA

Progress and Outcomes:

1a. Objectives (from AD-416):

To determine how salmon consumption alters lipid oxidation parameters in human plasma. In this work, we will quantify the content of omega-6 and omega-3 fatty acids in the plasma from participants in the GFHNRC human study that have consumed differing amounts of salmon as a source of omega-3 fatty acids. These data will provide information on the role of fish consumption upon markers of inflammation and oxidative stress. Attainment of this data may be useful in future deliberations of the dietary guidelines committee on the evidence base for long chain omega-3 fatty acid recommended intake levels.

1b. Approach (from AD-416):

The GFHNRC is responsible for performance of studies to assess the role of nutrition in obesity prevention and in the reduction of obesity related chronic diseases. The GFHNRC will perform the necessary salmon feeding trial and collection of plasma samples. Samples of plasma will be delivered to the cooperator for analysis of fatty acid oxidation products. The cooperator will also offer expertise in interpretation and writing of the results. Data will be presented and published with GFHNRC scientists and the cooperator as authors. The cooperator will also offer expertise in interpretation of the results of the phospholipid fatty acids.

3. Progress Report:

This report documents research conducted under a Specific Cooperative Agreement between ARS and the UNIVERSITY OF NORTH DAKOTA. Additional details for the research can be found in the report for the parent project 5450-51000-049-00D, DIETARY GUIDELINES ADHERENCE AND HEALTHY BODY WEIGHT MAINTENANCE

The intervention has been completed and most of the samples have been analyzed. The study has thus far resulted in two papers - one that is in press and one that is currently under review. The samples of plasma for analysis of fatty acid oxidation products have been delivered to the cooperator and are currently being analyzed. Once these results are available, a manuscript of the results well be prepared for submission.

ARS PI monitoring activities to evaluate research progress included: phone calls/conference calls, email communications, review of Accomplishment Report.

Project Number: 5450-51000-049-09S **Accession:** 0421842 **FY:** 2012

Approved: CHANDLER LAURENCE D **Date:** 09/24/2012

Project Number: 5450-51000-049-10S **Accession:** 0421980 **FY:** 2012

ModeCode: 5450-10-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
HEALTHY BODY WEIGHT RESEARCH

NPL Leader: JOHN W FINLEY **Prin Invs:** GERALD F COMBS

Start Date: 09/01/2011 **Term Date:** 08/31/2014

National Programs: 107 N Human Nutrition

Title: COMMUNITY NUTRITION AND PHYSICAL ACTIVITY PROGRAM

Period Covered **From:** 10/2011 **To:** 9 /2012 **Final Report?** No
Terminate in Two Months? No

Agreement Number: 58-5450-1-0346

Organization Name: GRAND FORKS PARK DISTRICT

Progress and Outcomes:

1a. **Objectives (from AD-416):**

To evaluate the efficacy and sustainability of diet and physical activity interventions to maintain healthy body weight and reduce risks factors for obesity-related chronic disease in a community setting.

1b. **Approach (from AD-416):**

The Healthy Body Weight Research Unit will conduct high-impact, community-based research on the roles of diet/physical activity in maintaining healthy body weight. To implement this vision, the Grand Forks Human Nutrition Research Center will collaborate with the Grand Forks Parks District (GFPD, a unit of the North Dakota State government) in conducting human studies designed to support the maintenance of healthy body weight, reduce unhealthy weight gain, and reduce risk of obesity-related conditions. This will involve the use of GFPD facilities, including a community wellness center equipped with a wide variety of exercise equipment (treadmills, step machines, stationary cycles, rowing machines, free weights), indoor pools, indoor/outdoor walking/jogging trails, demonstration kitchen and meeting rooms. These will be used recruit volunteers to studies; conduct diet/physical activity interventions; collect specimens (blood, urine and/or stool samples), and perform a variety of evaluations (anthropometry, body composition, physiological responses to exercise) through study participants. With the results of these studies, the Healthy Body Weight Research Unit will determine the specific features of diet/physical activity practices that contributed to successful healthy body weight management as part of the evidence base for the Dietary Guidelines for Americans process.

3. **Progress Report:**

This report documents research conducted under a Specific Cooperative Agreement between ARS and the GRAND FORKS PARK DISTRICT. Additional details for the research can be found in the report for the parent project 5450-51000-049-00D, DIETARY GUIDELINES ADHERENCE AND HEALTHY BODY WEIGHT MAINTENANCE

Grand Forks Human Nutrition Research Center scientists worked with Grand Forks Park District program planners to complete the monitored physical activity component of a study of the effect of dietary protein level on the retention/loss of muscle protein and bone mineral contents during a period of negative energy balance. This showed that a moderate elevation in protein intake can reduce the loss of muscle protein in exercising individuals during a prolonged period of moderately negative energy balance.

Project Number: 5450-51000-049-10S **Accession:** 0421980 **FY:** 2012

Planning has been completed for a collaborative study of motivation for physical activity.

ARS PI monitoring activities to evaluate research progress included: phone calls/conference calls, on-site Cooperator/ARS meetings, site visits, email communications, review of Accomplishment Report.

Approved: CHANDLER LAURENCE D **Date:** 09/24/2012

Project Number: 5450-51000-049-11S **Accession:** 0422113 **FY:** 2012

ModeCode: 5450-10-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
HEALTHY BODY WEIGHT RESEARCH

NPL Leader: JOHN W FINLEY **Prin Invs:** LISA A JAHNS

Start Date: 09/15/2011 **Term Date:** 09/14/2016

National Programs: 107 N Human Nutrition

Title: UTILIZATION OF A SKIN CAROTENOID DETECTION DEVICE TO DETERMINE FRUIT AND VEGETABLE INTAKE

Period Covered **From:** 10/2011 **To:** 9 /2012 **Final Report?** No
Terminate in Two Months? No

Agreement Number: 58-5450-1-0355

Organization Name: UNIVERSITY OF UTAH

Progress and Outcomes:

1a. **Objectives (from AD-416):**

To validate skin carotenoid detection as a marker of fruit and vegetable intake to study the possible health effects that accumulate in human skin, which reflect dietary intake from food sources. Validation through a skin carotenoid detection device would allow researchers better tools for studying strategies to increase fruit and vegetable consumption in large populations and groups of people in whom non-invasive techniques are especially preferred (e.g. children).

1b. **Approach (from AD-416):**

The Grand Forks Human Nutrition Research Center (GFHNRC) studies healthy diets based on the Dietary Guidelines and how they can help people maintain a healthy body weight, as well as prevent obesity and other chronic health problems. Fruits and vegetables are an important component to a healthy diet and many Americans do not eat the recommended amount of fruits and vegetables. There are many research efforts looking at ways to increase consumption of fruits and vegetables, however, there is a need to develop better ways to assess fruit and vegetable intake in people. Validation of skin carotenoid detection as a marker of fruit and vegetable intake will be accomplished through a controlled feeding study conducted at the GFHNRC. Study volunteers will be fed (on an outpatient basis) a diet initially devoid of carotenoids ("wash-out period") followed by a diet rich in carotenoids. A skin carotenoid detection device will be used to monitor skin carotenoid levels in response to increases in intake of vegetables and fruits.

3. **Progress Report:**

This report documents research conducted under a Specific Cooperative Agreement between ARS and the UNIVERSITY OF UTAH. Additional details for the research can be found in the report for the parent project 5450-51000-049-00D, DIETARY GUIDELINES ADHERENCE AND HEALTHY BODY WEIGHT MAINTENANCE

This research project includes an ancillary project validating the use of resonance Raman spectroscopy for measuring skin carotenoid levels as a non-invasive tool to assess fruit & vegetable (F&V) intake (blood carotenoid levels are the current standard biomarker for F&V intake). This project is a collaboration with investigators at Yale University and the University of Utah. Data collection for half of the volunteers is completed; the 2nd half of the volunteers will completed the study in August 2012. One abstract has been published (and presented as an oral abstract at the annual

Project Number: 5450-51000-049-11S **Accession:** 0422113 **FY:** 2012

Experimental Biology meeting).

ARS PI monitoring activities to evaluate research progress included: phone calls/conference calls, on-site Cooperator/ARS meetings; site visits, email communications, discussions at professional conferences/meetings, review of Accomplishment Report.

Approved: CHANDLER LAURENCE D **Date:** 09/24/2012

Project Number: 5450-51000-049-19T **Accession:** 0421444 **FY:** 2012

ModeCode: 5450-10-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
HEALTHY BODY WEIGHT RESEARCH

NPL Leader: JOHN W FINLEY **Prin Invs:** SUSAN K RAATZ

Start Date: 04/08/2011 **Term Date:** 05/31/2013

National Programs: 107 N Human Nutrition

Title: GLYCEMIC EFFECT OF HONEY

Period Covered **From:** 10/2011 **To:** 9 /2012 **Final Report?** No
Terminate in Two Months? No

Agreement Number: 58-5450-1-0424

Organization Name: NATIONAL HONEY BOARD

Progress and Outcomes:

1a. **Objectives (from AD-416):**

Honey has been used as a sweetener for centuries. Recent data indicate that honey consumption may have beneficial effects upon glucose intolerance, a health issue currently affecting 57 million Americans of every age and ethnicity. In order to evaluate the glycemic effect of honey, we will carry out a human trial assessing biomarkers of blood glucose responses, insulin sensitivity, and inflammatory markers. Animal studies, using a model of obesity-induced glucose intolerance, will be performed to examine physiologic and biochemical mechanisms by which honey ameliorates obesity-induced glucose intolerance. All studies will be carried out at the USDA Grand Forks Human Nutrition Research Center (GFHNRC).

Our primary objective is to determine the glycemic effects of honey in comparison to sucrose and high fructose corn syrup. We hypothesize that honey will promote improved glucose tolerance and insulin sensitivity compared to both sugar and high fructose corn syrup in normal glycemic and glucose intolerant overweight and obese adults as well as in an animal model of insulin resistance. Our specific aims include (1) evaluation of the effects of the consumption of honey vs. HFCS vs. sugar on glucose tolerance in normoglycemic and glucose intolerant humans, and (2) determine the extent to which honey consumption alters the physiologic and biochemical pathways of glucose intolerance.

1b. **Approach (from AD-416):**

1) We will evaluate the effect of honey vs. other nutritive sweeteners on insulin sensitivity in 60 overweight adult volunteers. At baseline subjects will be randomized in a Latin square design to one of the nutritive sweeteners (honey, HFCS 55, sucrose) and undergo an oral glucose tolerance test (OGTT). They will then consume 50g of CHO of the assigned treatment daily for a 14 day period followed by a repeat OGTT. A wash out period of 1-2 weeks will be carried out before assignment to the 2nd and 3rd treatments.
2) Rodent studies will be performed to complement the clinical studies described above. We will utilize a controlled model of obesity-induced glucose intolerance to define the positive effects of honey consumption upon insulin-resistance, oxidative stress, and inflammation and define the mechanisms for these positive effects.

3. **Progress Report:**
This report documents research conducted under a Trust Agreement between ARS and the

Project Number: 5450-51000-049-19T **Accession:** 0421444 **FY:** 2012

NATIONAL HONEY BOARD. Additional details for the research can be found in the report for the parent project 5450-51000-049-00D, DIETARY GUIDELINES ADHERENCE AND HEALTHY BODY WEIGHT MAINTENANCE

Eleven participants have completed the trial and five more are currently undergoing the intervention.

Approved: CHANDLER LAURENCE D **Date:** 10/22/2012

Project Number: 5450-51000-049-20T **Accession:** 0422260 **FY:** 2012

ModeCode: 5450-10-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
HEALTHY BODY WEIGHT RESEARCH

NPL Leader: JOHN W FINLEY **Prin Invs:** SUSAN K RAATZ

Start Date: 10/01/2011 **Term Date:** 12/31/2013

National Programs: 107 N Human Nutrition

Title: BIOAVAILABILITY STUDY OF FISH OILS: EMULSIFIED VS. CAPSULAR TRIGLYCERIDE

Period Covered **From:** 10/2011 **To:** 9 /2012 **Final Report?** No
Terminate in Two Months? No

Agreement Number: 58-5450-2-0401

Organization Name: THE DYSON FOUNDATION

Progress and Outcomes:

1a. **Objectives (from AD-416):**

The primary objective of this investigation is to determine the relative percentage and rate of incorporation of eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA) and total omega-3 (n-3) fatty acids after ingestion of emulsified flavored triglyceride fish oil supplements (Coromega Squeeze™, Coromega Nectar™, and Barlean Swirl™) versus pure encapsulated triglyceride (Nordic Naturals Omega-3 Softgels™) in defined plasma lipid pools.

The primary endpoints to be evaluated include the fatty acid composition of plasma lipids before and after consumption of a single dose of emulsified triglyceride based fish oils and triglyceride of similar n-3 compositions in capsule form. We will measure changes in plasma total, phospholipid, and chylomicron fatty acids.

1b. **Approach (from AD-416):**

A randomized and crossover design will be employed to compare absorption kinetics of EPA, DPA and DHA in 10 subjects consuming of Coromega Squeeze™, Coromega Necta™r, Barlean Swirl™ emulsified or the equivalent of the parent oil, Nordic Naturals Omega-3 fish oil™. Study subjects will include healthy adults between the ages of 18 to 60. The supplemental doses will be designed to provide equivalent amounts of EPA, DPA and DHA.
Study subjects will randomly receive fish oil as either the Coromega Squeeze', Coromega Nectar' , Barlean Swirl' (to match EPA), or Nordic Omerga-3 Softgel' supplements after an overnight fast. Whole blood samples will be drawn at baseline, immediately prior to supplementation, and at 2, 4, 8, 24 and 48 hours post supplementation. Food will be restricted during the first 8 hours following the administration of test articles. Following the 8-hour sample, subjects will be allowed to return home and consume a low fat diet devoid of long chain omega 3, i.e., no fish meals or eggs until the 48 hour sample has been drawn. The subjects will again be asked to fast overnight and return to the center for the 24 and 48 hour sampling, respectively. The second arm of the study will be repeated 6 weeks following the initial arm to guarantee adequate washout. Subjects will be asked to consume a low n-3 diet between testing periods and will be provided dietary guidance on foods to avoid. Subjects will be asked to complete a "Tolerance Questionnaire" 4 hours after consumption of the fish oil supplement.

3. **Progress Report:**

Project Number: 5450-51000-049-20T **Accession:** 0422260 **FY:** 2012

This report documents research conducted under a Trust Agreement between ARS and THE DYSON FOUNDATION. Additional details for the research can be found in the report for the parent project 5450-51000-049-00D, DIETARY GUIDELINES ADHERENCE AND HEALTHY BODY WEIGHT MAINTENANCE

There was a delay in start-up due to unavailability of one of the test products. The Dyson Foundation has therefore approved a no-cost extension of the grant through 12/2013. IRB approval has been obtained and participants are currently being recruited. Two subjects have started the trial and no data is yet available.

Approved: CHANDLER LAURENCE D **Date:** 09/24/2012

Project Number: 5450-51000-049-21T **Accession:** 0422874 **FY:** 2012

ModeCode: 5450-10-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
HEALTHY BODY WEIGHT RESEARCH

NPL Leader: JOHN W FINLEY **Prin Invs:** SUSAN K RAATZ

Start Date: 03/15/2012 **Term Date:** 12/31/2013

National Programs: 107 N Human Nutrition

Title: LIFESTYLE MODIFICATION AND POTATO CONSUMPTION

Period Covered **From:** 10/2011 **To:** 9 /2012 **Final Report?** No
Terminate in Two Months? No

Agreement Number: 58-5450-2-0409

Organization Name: U.S. POTATO BOARD

Progress and Outcomes:

1a. **Objectives (from AD-416):**

Potatoes are widely used throughout the world as a staple food. Recently, their role in the diet has been questioned, particularly in relation to glycemia and the risk of developing type 2 diabetes mellitus. We challenge that notion, and propose that consuming potatoes as part of a mixed meal can be a healthy adjunct to lifestyle modification for reducing risk markers of cardiometabolic disease. In order to test this hypothesis, we will carry out a controlled feeding trial with overweight/obese volunteers in which we will compare potatoes containing high or low amounts of resistant starch to other commonly consumed carbohydrate sources in a lifestyle modification program. We will assess the effects of those treatments on biomarkers of cardiometabolic risk: blood glucose responses, insulin sensitivity, lipids and inflammatory markers. These studies will be carried out at the USDA Grand Forks Human Nutrition Research Center (GFHNRC).

1b. **Approach (from AD-416):**

Our primary objective is to compare the cardiometabolic effects of potato consumption to those of commonly consumed carbohydrate sources on glucose tolerance in overweight and obese, glucose intolerant men and women participating in a lifestyle intervention program. We hypothesize that consumption of potatoes is a healthy adjunct to lifestyle intervention in overweight and obese glucose intolerant adults. Our specific aims include: (1) to evaluate of the effects of the consumption of potatoes (high or low resistant starch) vs. commonly consumed carbohydrate sources on glucose tolerance; and (2) to determine the extent to which potato consumption alters markers of lipid metabolism and inflammation in the context of a lifestyle intervention program.

3. **Progress Report:**

This report documents research conducted under a Trust Agreement between ARS and the U.S. POTATO BOARD. Additional details for the research can be found in the report for the parent project 5450-51000-049-00D, DIETARY GUIDELINES ADHERENCE AND HEALTHY BODY WEIGHT MAINTENANCE

The 8-week group weight management program is being developed. Analysis of the resistant starch content of the potato products is currently being done and these data will be used to develop the recipes for the intervention. The IRB application is under development. Subject recruitment has not yet started. The study schedule is right on target. No data are yet available.

Project Number: 5450-51000-049-21T **Accession:** 0422874 **FY:** 2012

Approved: CHANDLER LAURENCE D **Date:** 10/07/2012

DIETARY PREVENTION OF OBESITY-RELATED DISEASE RESEARCH

MANAGEMENT UNIT

5450-020-00

Project Number: 5450-51000-045-00D **Accession:** 0418779 **FY:** 2012

ModeCode: 5450-20-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
DIETARY PREVENTION OF OBESITY-RELATED DISEASE RESEARCH

NPL Leader: DAVID M KLURFELD **Prin Invs:** HUAWEI ZENG

Start Date: 03/17/2010 **Term Date:** 09/30/2014

National Programs: 107 N Human Nutrition

Title: DIETARY MODULATION OF OBESITY-RELATED CANCER BY SELENIUM

Period Covered **From:** 10/2011 **To:** 9 /2012 **Final Report?** No
Terminate in Two Months? No

Progress and Outcomes:

1a. Objectives (from AD-416):

Determine the dietary modulation of obesity-related cancer by selenium. Specific objectives include 1) Characterize interactions of energy imbalance and dietary Se status on obesity-promoted carcinogenesis; 2) Elucidate the relationship of body mass index (BMI) and features of Se metabolism in selenoprotein genotypes differing in cancer risk.

1b. Approach (from AD-416):

This project will determine the extent to which Se counteracts the carcinogenic effects of obesity. It will do so by elucidating the effects of Se status on obesity-promoted mechanisms of carcinogenesis, and the relationships of BMI and Se metabolism among individuals of two genotypes known to differ in cancer risk. Two forms of dietary Se will be used:
i) SeMet, the dominant form of Se in foods;
ii) precursors of CH3SeH - CH3SeCys (catabolyzed to CH3SeH in the cell), the methylseleninic acid (MSeA) (reduced to CH3SeH in the cell), and the combination of SeMet + recombinant methionase (produces CH3SeH).
The project utilizes the complementary expertise of the research team in molecular/cell biology and cell signaling (Zeng), experimental tumorigenesis (Yan, Zeng), human Se metabolism (Combs), and chemistry/ biochemistry (Jackson, Combs). The collaborative nature of the project is evident in the CH3SeH metabolism/action theme that connects the two objectives. This research builds on in-depth expertise and existing collaborations to investigate a highly relevant problem hitherto not addressed. The Grand Forks Human Nutrition Research Center provides this team of investigators with an experienced professional infrastructure for the efficient recruitment and management of human subjects and the controlled use of animal and cell models.

2. Milestones for FY2012:

1. Make sure diets and animal housing work well; Collect animal tissues; perform NMR scan and colon tumor analysis
   Milestone Fully Met

2. Complete inflammatory cytokine, MAPK/APC pathway
   Milestone Fully Met

3. Complete data analyses and prepare report for exp 1. Initiate animal feeding, data collection, related assays and analysis for experiments of i.v. and s.c. injection

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models for Se compounds and secondary tumor development (exp 2).
Milestone Fully Met

4. Recruiting; start sample collection and analyses for Subobjective 2A; Hypothesis 2A
Milestone Fully Met

5. Develop protocol; gain IRB approval; begin recruiting and screening for Subobjective 2A; Hypothesis 2B.1.
Milestone Fully Met

6. Complete data analyses, Prepare report for animal study (Exp 1). Develop analytical methodology for trapping of methylselenol (Exp 2). Subobjective 2A; Hypothesis 2B.2
Milestone Fully Met

3. **Progress Report:**
To determine the extent to which Se reduces a high fat diet related colon cancer, we established an oral daily Se ingestion method in C57/BL mice fed with low/high fat diets. A study was completed on the inhibitory effect of CH3SeH on both colon cancer proliferation (in vitro) and tumor growth potential in a colon cancer mouse model. We now are working on molecular/biochemical analyses.

To determine the connection between gut microfloral and inflammation status, we have been simultaneously examining the effect of the consumption of a high fat diet on (a) the inflammatory process including colon cell proliferation, cytokine expression, nonalcoholic fatty liver disease; and (b) gut microfloral status in both cell culture and mouse models. We now are preparing a manuscript.

The roles of selenium in secondary cancer prevention remain largely unexplored. We hypothesized that selenium reduces metastasis. We completed animal feeding experiments that 1) assessed the interaction of selenium and diet-induced obesity on spread of malignancy; and 2) compared 4 different selenium compounds on breast cancer metastasis in mice, and we initiated data analysis for these experiments.

Physical exercise and dietary modification may reduce the risk of obesity. We hypothesized that exercise and soy protein may have a synergistic effect, and completed an animal feeding experiment that assessed interactions of soy protein and voluntary running on diet-induced obesity and changes in related inflammatory and angiogenic markers in mice.

Analyses of our earlier work have suggested that Se supplementation may increase risk of type 2 diabetes. We decided to test this using a large cohort study because a trial to test this hypothesis is unethical. Completed the design of that study (involving 500 free-living human subjects) and are currently requesting IRB approval. Its specific objective is to determine the relationship between glycemia, adiposity and Se status.

We have observed that apparently healthy, obese (BMI>30) individuals have sub-optimal expression of Se transport protein, SEPP1. We hypothesized that impaired hepatic methylation capacity, common in obesity, may alter metabolism of Se. We are testing these hypotheses in two ways: a) determining the pools of Se metabolites that require methylation which includes low molecular weight Se metabolites. b) Determining the effects of impaired hepatic methylation capacity on the regulation of Se-containing

proteins. The results of these studies demonstrated that compromised methylation capacity affects the metabolism of Se metabolites thought to be anti-carcinogenic. We are preparing two manuscripts to a high-impact journal.

4. Accomplishments

01 Selenium (Se) metabolites reduce a high fat diet related colon cancer. To address the question whether Se reduces a high fat diet related colon cancer, ARS researchers in Grand Forks, ND, examined the effect of Se on tumor growth potential in a colon cance mouse model. Our data demonstrated, for the first time, that Se (CH3SeH) reduced both colon cancer proliferation (in vitro) and tumor growth potential (in vivo) in a color cancer mouse model with a high fat diet; the Se-modulation of p53 tumor suppressor pathway played a key role in this anticancer action. These findings provide new insights into the mechanistic process of Se anticancer property, which is the scientific basis for using Se to prevent a high fat diet related colon cancer.

107 2 A 2009

107 3 A 2009

02 Selenium (Se) reduces metastasis. Metastasis is the most devastating aspect of cancer, and its occurrence directly affects the survival and quality life of cancer survivors. ARS researchers in Grand Forks, ND, used a mouse cancer model and demonstrated that dietary supplementation with methylseleninic acid (an active Se form) reduces malignant spread of cancer cells in mice, and this reduction is associated with its inhibition of the plasminogen activator system and angiogenesis. These results indicate that Se may be a useful adjuvant in secondary cancer prevention, and its possible application warrants further investigation.

107 2 A 2009

107 3 A 2009

03 Curcumin enhances metastatic growth in mice. Metastasis directly affects the survive and quality life of cancer survivors. ARS researchers in Grand Forks, ND, used a mous cancer model and demonstrated that dietary supplementation with curcumin, a component of the spice turmeric, enhances metastatic growth in mice. This enhancement is accompanied with increases in plasma levels of angiogenic factors and inflammatory cytokines. The role of curcumin in the development and growth of malignancies with rapid progression, including metastasis, warrants further investigation.

107 2 A 2009

107 3 A 2009

04 Voluntary exercise improves adiposity in young adult mice. Obesity among children ar adolescents continues to be a public health concern in the U.S. ARS researchers in Grand Forks, ND, demonstrated that long-term voluntary running improves diet-induced adiposity in young adult mice, which is accompanied with reduction in plasma levels c insulin, adipokines and inflammatory cytokines. These results indicate that voluntar running reduces diet-induced obesity and pro-inflammation and that young mice may be useful model of their human age equivalents in studying moderate physical exercise ar obesity and obesity-related diseases.

107 2 A 2009

107 3 A 2009

05 The metabolism of dietary selenium (Se) forms in healthy adults. Metabolites of dietary selenium are known to decrease carcinogenesis. ARS researchers in Grand Forks ND, used pharmacokinetic approaches to characterize the metabolism of two major dietary forms of Se, selenomethionine and selenite. Human volunteers were given nutritional doses of two forms of dietary Se each labeled with a different marker. Th

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marker allowed the measurement of the uptake and turnover of each Se species under normal conditions. These data provide new insights on Se metabolism, which provides the scientific basis for making dietary Se intake guideline.

107 2 A 2009
107 3 A 2009

06. Selenoprotein P expression is reduced when the capacity for methylation is reduced, a occurs in many obese individuals. Reduced expression of selenoprotein P, which transports selenium through the body, reduces the health functions of selenium. ARS researchers at the Grand Forks Human Nutrition Research Center discovered that the synthesis of selenoprotein P in human liver cells depends on the methylation of protein factors that regulate its gene expression. These proteins are also involved in glycemic control, loss of which occurs in type 2 diabetes. This new information shows that selenium status is related to risk to obesity-related disease.

107 2 A 2009
107 3 A 2009

5. **Significant Activities that Support Special Target Populations:**

6. **Technology Transfer:**

0 **Number of New CRADAs**
0 **Number of Active CRADAs**
1 **Number of New MTAs (providing only)**
0 **Number of Invention Disclosures Submitted**
0 **Number of Patent Applications Filed**
0 **Number of New Germplasm Releases**
0 **Number of new commercial licenses granted**
0 **Number of web sites managed**
0 **Number of non-peer reviewed presentations and proceedings**
0 **Number of newspaper articles and other presentations for non-science audiences**
7 **Number of Other Technology**

New MTA (providing only) Details:

01 **MTA ID:** 9446
PCNA promoter-luciferase plasmid
Technology:Report plasmid construct PCNA promoter-luciferase to be used for luciferase reporter assays
Customer/User: University of Edinburgh - United Kingdom
Impact/Outcome: No known impact at this time

Other Technology Details:

01 **Description:** Two presentations at the North Dakota State University, Summer Research Forum. The topics were on dietary selenium (Se) and the mechanistic aspect of cancer prevention.
Transfer/ Customer/user:
New information on Se metabolism and cancer prevention was transferred orally to a group of academic investigators.

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02 **Description:** Two presentations at the 10th International Conference: Bioactive Compounds and Functional Foods in Health and Disease. The topics were on dietary sulforaphane, Se and their mechanistic aspects of cancer prevention.
Transfer/ Customer/user:
New information on the mechanistic aspects of anticancer nutrients (e.g., sulforaphane, Se) was transferred orally to a group of academic and industrial investigators.

03 **Description:** Two presentations at the New York Academy of Sciences. The topics were on nutritional biomarkers and Se metabolism.
Transfer/ Customer/user:
New information on nutritional biomarkers and Se metabolism was transferred orally to a group of academic and industrial investigators.

04 **Description:** One presentation at the McGill-INLEN Agriculture/Health/Wealth Convergence workshop. The topic was on agriculture, nutrition and health.
Transfer/ Customer/user:
New information on linkages of agriculture, nutrition and health was transferred orally to an international group of researchers, policy makers, food industry executives and government regulators.

05 **Description:** Two presentations at the Federation of American Societies for Experimental Biology. The topics were on the dietary Se intake, methylation status and secondary cancer prevention.
Transfer/ Customer/user:
New information on Se metabolism and cancer prevention was transferred orally to a group of academic and industrial investigators.

06 **Description:** One presentation to 103rd Annual Meeting of American Association for Cancer Research. The topic was on physical activity and secondary cancer risk.
Transfer/ Customer/user:
New information on physical activity and cancer prevention was transferred to a group of academic and industrial investigators.

07 **Description:** Two Grand Forks Herald article publications. The topics were on benefits of flaxseed and the issue of Snack Smart.
Transfer/ Customer/user:
New information on American food/nutrition choice was transferred to American public.
Impact/outcome:
The above 7 major activities have been promoting scientific excellence and American public view on the scientific nutrition practice. Furthermore, these efforts also provide the scientific basis for policy makers.

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7. International Cooperation / Collaboration

01 UNITED KINGDOM

We collaborated with the scientists at the University of Edinburgh, UK, for studies biomarkers for early detection of cancer. These work exchanges take place by email and telephone. We have exchanged some experimental materials, however, no funds have been involved.

02 DENMARK

We collaborated with the scientists at the University of Copenhagen, DA, in the speciation of metabolites of selenium. These work exchanges take place by email and telephone. We have exchanged some experimental materials, however, no funds have been involved.

Scientific Publications: **Log 115**

1. Yan, L., Demars, L.C. 2011. Effects of non-motorized voluntary running on experimental and spontaneous metastasis in mice. Anticancer Research. 31:3337-3344. **000026574**

2. Combs, G.F., Jackson, M.I., Watts, J.J., Johnson, L.K., Zeng, H., Idso, J.P., Schomburg, L., Hoeg, A., Hoefig, C.S., Chiang, E.C., Waters, D.J., Tsuji, P.A., Davis, C.D., Milner, J.A. 2011. Differential responses to selenomethioinine supplementation by sex and genotype in healthy adults. British Journal of Nutrition. doi:10.1017/S0007114511004715. **000025987**

3. Murphy, K.M., Hoagland, L.A., Yan, L., Colley, M., Jones, S.S. 2011. Genotype × Environment interactions for mineral concentration in grain of organically grown spring wheat. Agronomy Journal. 103:1734-1741. **000026405**

4. Jerome-Morais, A., Wright, M.E., Liu, R., Yang, W., Jackson, M.I., Combs, G.F., Diamond, A.M. 2011. Inverse association between gluthathione peroxidase activity and both selenium-binding protein 1 levels and gleason score in human prostate tissue. The Prostate Journal. doi:10.1002/pros.21506. **000027945**

5. Combs, G.F., Watts, J.J., Jackson, M.I., Johnson, L.K., Zeng, H., Scheett, A.J., Uthus, E.O., Schomburg, L., Hoeg, A., Hoefig, C.S., Davis, C.D., Milner, J.A. 2011. Determinants of selenium status in healthy adults. Nutrition Journal. doi:10.1186/1475-2891-10-75. **000025985**

6. Gammelgaard, B., Jackson, M.I., Gabel-Jensen, C. 2011. Surveying selenium speciation from soil to cell—forms and transformations. Analytical and Bioanalytical Chemistry. 399:1743-1763. **000026408**

7. Yan, L., Demars, L.C., Johnson, L.K. 2012. Long-term voluntary running improves diet-induced adiposity in young adult mice. Nutrition Research. 32:458-465. **000027749**

8. Yan, L. 2012. Dietary supplementation with curcumin enhances metastatic growth of Lewis lung carcinoma in mice. International Journal of Cancer. doi: 10.1002/ijc.27683. **000027985**

9. Zeng, H., Cheng, W., Johnson, L.K. 2012. Methylselenol, a selenium metabolite, modulates p53 pathway and inhibits the growth of MC-26 colon cancer xenografts in balb/c mice. Journal of Nutritional Biochemistry. DOI:10.1016/j.nutbio.2012.04.008. **000027575**

10. Cheng, W., Holmstrom, A., Li, X., Wu, R.T., Zeng, H., Xiao, Z. 2012. Effect of dietary selenium and cancer cell xenograft on peripheral T and B lymphocyte in adult nude mice. Biological Trace Element Research. 146(2):230-5. **000026966**

11. Holmstrom, A., Zeng, H., Lei, K., Cheng, W., Wu, R. 2012. Nutritional and **000026486**

Project Number: 5450-51000-045-00D **Accession:** 0418779 **FY:** 2012

supranutritional levels of selenate differentially suppress prostate tumor growth in adult but not young nude mice. Journal of Nutritional Biochemistry. 23(9):1086-91.

12. Li, G., Yuan, K., Fox, J., Gaid, M., Seeger, D., Weaver, A., Breitwieser, W., Bansal, A.K., Zeng, H., Gao, H., Wu, M. 2012. 8-oxoguanine DNA glycosylase 1-deficiency modifies allergic airway inflammation by regulating STAT6 and IL-4 in cells and in mice. Free Radicals in Biology and Medicine. 15;52(2):392-401. **000026423**

13. Zhang, S., Luo, Y., Zeng, H., Wang, Q., Tian, F., Song, J., Cheng, W. 2011. Encapsulation of selenium in chitosan nanoparticles improves selenium availability and protects cells from selenium-induced DNA damage response. Journal of Nutritional Biochemistry. 22(12):1137-42. **000025800**

14. Zeng, H., Briske Anderson, M.J., Wu, M., Moyer, M.P. 2012. Methylselenol, a selenium metabolite, plays common and different roles in cancerous colon HCT116 cell and noncancerous NCM460 colon cell proliferation. Nutrition and Cancer. 64(1):128-35. **000025502**

Approved: MCGUIRE MICHAEL R **Date:** 09/27/2012

Project Number: 5450-51000-045-02S **Accession:** 0414720 **FY:** 2012

ModeCode: 5450-20-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
DIETARY PREVENTION OF OBESITY-RELATED DISEASE RESEARCH

NPL Leader: DAVID M KLURFELD **Prin Invs:** GERALD F COMBS

Start Date: 09/29/2008 **Term Date:** 09/28/2013

National Programs: 107 N Human Nutrition

Title: FOOD-BASED OBESITY PREVENTION AND HEALTH MAINTENANCE RESEARCH

Period Covered **From:** 10/2011 **To:** 9 /2012 **Final Report?** No
Terminate in Two Months? No

Agreement Number: 58-5450-8-0342

Organization Name: UNIVERSITY OF NORTH DAKOTA

Progress and Outcomes:

1a. **Objectives (from AD-416):**

The objective of this cooperative research is to investigate the role of foods and their components in human health, with particular focus on the prevention of obesity, including the endogenous (biological) and exogenous (psycho-social, environmental) factors that affect the maintenance of healthy body weight and risk to co-morbidities of obesity.

1b. **Approach (from AD-416):**

Conduct studies with human volunteers to elucidate functions of and quantitative needs for nutrients and/or other components of foods and physical activity in the support of healthy body weight and minimization of risk to chronic disease. Includes focus groups, cross-sectional and clinical intervention studies in both residential and non-residential settings involving volunteers recruited from Grand Forks and other communities.

3. **Progress Report:**

This report documents research conducted under a Specific Cooperative Agreement between ARS and the UNIVERSITY OF NORTH DAKOTA. Additional details for the research can be found in the report for the parent project 5450-51000-045-00D, DIETARY MODULATION OF OBESITY-RELATED CANCER BY SELENIUM

Ten protocols involving human studies were managed this year. This included both residential and out-patient studies addressing the bioavailability of n3-fatty acids from salmonid fishes, the effects of dietary protein level of muscle protein during negative energy balance, the effect of vitamin D status on preeclampsia risk, the use of palmer laser raman scanning to assess carotenoid status, the use of breath 12C:13C ratio to assess energy substrate utilization.

ARS PI monitoring activities to evaluate research progress included: phone calls/conference calls, email communications, discussions at professional conferences/meetings, review of Accomplishment Report.

Approved: CHANDLER LAURENCE D **Date:** 09/24/2012

Project Number: 5450-51000-045-04A **Accession:** 0418389 **FY:** 2012

ModeCode: 5450-20-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
DIETARY PREVENTION OF OBESITY-RELATED DISEASE RESEARCH

NPL Leader: DAVID M KLURFELD **Prin Invs:** GERALD F COMBS

Start Date: 09/25/2009 **Term Date:** 09/24/2014

National Programs: 107 N Human Nutrition

Title: HUMAN OBESITY PREVENTION RESEARCH

Period Covered **From:** 10/2011 **To:** 9 /2012 **Final Report?** No
Terminate in Two Months? No

Agreement Number: 59-5450-9-0336

Organization Name: UNIVERSITY OF NORTH DAKOTA

Progress and Outcomes:

1a. Objectives (from AD-416):

This award will benefit the people of the United States by producing new knowledge that will significantly improve the evidence base for national food, nutrition and health policies. It will bring together two entities, the ARS and the University of North Dakota, each with strong scientific and technical capabilities to produce a combined effort that is unparalleled in its ability to design and conduct human clinical intervention trials addressing the knowledge gaps critical to policy development for reversing the national epidemic of obesity and its co-morbidities. This research will be among the first to test the efficacy and sustainability of U.S. Dietary Guidelines. It will thus be seminal in supporting the further development of those guidelines as well as related national policy concerning food, nutrition and health. Improved national policy will benefit the people of the United States by reducing the prevalence of obesity and obesity-attributable health care costs.

1b. Approach (from AD-416):

This research will address the prevention of childhood/adult obesity, which involves food choices/patterns, physical activity and energy balance, metabolism/physiology, genotype/phenotypic expression, food access/composition, attitudes/traditions, and processes that can lead to diabetes, cancer, heart disease and osteoarthritis. This demands innovative, translational research to generate new knowledge and improve the evidence base for national nutrition/health/food policy. This will be accomplished in this project by addressing the following areas:
1. U.S. Dietary Guidelines Adherence and Healthy Body Weight. Research to identify barriers/ facilitators to adhering to the Dietary Guidelines.
2. Biology of Obesity Prevention. Research on metabolism/physiology affected by diet/physical activity in maintaining healthy body weight; use of "omics" tools to understand individuals' responses to interventions and propensities to gain weight.
3. Food Factors in Maintaining Health & Healthy Body Weight. Research examining the effects of food antioxidants on metabolic responses to exercise.
4. Body Weight and Bone Health. Research on the roles of adiposity and body weight on inflammation and bone health.
5. Diet and Physical Activity in Mitigating Obesity-Promoted Carcinogenesis. Research on the effects of adiposity on the metabolism and anticarcinogenic mechanisms of selenium.

Project Number: 5450-51000-045-04A **Accession:** 0418389 **FY:** 2012

3 . **Progress Report:**

This report documents research conducted under an Assistance Type Cooperative Agreement between ARS and the UNIVERSITY OF NORTH DAKOTA. Additional details for the research can be found in the report for the parent project 5450-51000-045-00D, DIETARY MODULATION OF OBESITY-RELATED CANCER BY SELENIUM

Please refer to the parent project report for research information.

ARS PI monitoring activities to evaluate research progress included: phone calls/conference calls, email communications, discussions at professional conferences/meetings, review of Accomplishment Report.

Approved: CHANDLER LAURENCE D **Date:** 11/07/2012

Project Number: 5450-51000-045-09R **Accession:** 0418478 **FY:** 2012

ModeCode: 5450-20-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
DIETARY PREVENTION OF OBESITY-RELATED DISEASE RESEARCH

NPL Leader: DAVID M KLURFELD **Prin Invs:** GERALD F COMBS

Start Date: 08/28/2009 **Term Date:** 08/31/2012

National Programs: 107 N Human Nutrition

Title: LIPID-BASED MICRONUTRIENT SUPPLEMENTS FOR INFANTS AND LACTATING WOMEN

Period Covered **From:** 10/2011 **To:** 9 /2012 **Final Report?** Yes
Terminate in Two Months? No

Agreement Number: 58-5306-0-0168

Organization Name: UNIVERSITY OF NORTH CAROLINA

Progress and Outcomes:

1a. **Objectives (from AD-416):**

To provide the evidence base for improving the vitamin and mineral status of lactating women and their infants.

1b. **Approach (from AD-416):**

Measure vitamin and mineral status of lactating women and their infants, given a placebo vs. a micronutrient-rich, lipid-based supplement; existing samples will be used from 300 women-infant pairs in Malawi.

3. **Progress Report:**

This report documents research conducted under a Reimbursable Agreement between ARS and the UNIVERSITY OF NORTH CAROLINA. Additional details for the research can be found in the report for the parent project 5450-51000-045-00D, DIETARY MODULATION OF OBESITY-RELATED CANCER BY SELENIUM

Analyses of selenium, protein and the extracellular selenium-dependent glutathione peroxidase were completed in serum and breast milk samples from 300 mother-infant pairs. Data were reported to our collaborators at the ARS Western Human Nutrition Research Center and the University of North Carolina.

Approved: CHANDLER LAURENCE D **Date:** 10/07/2012

Project Number: 5450-51000-046-00D **Accession:** 0419343 **FY:** 2012

ModeCode: 5450-20-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
DIETARY PREVENTION OF OBESITY-RELATED DISEASE RESEARCH

NPL Leader: JOHN W FINLEY **Prin Invs:** JAY J CAO

Start Date: 04/09/2010 **Term Date:** 09/30/2014

National Programs: 107 N Human Nutrition

Title: BONE METABOLISM IN OBESITY

Period Covered **From:** 10/2011 **To:** 9 /2012 **Final Report?** No
Terminate in Two Months? No

Progress and Outcomes:

1a. Objectives (from AD-416):

To determine how nutritional, hormonal, and physiological factors affect bone loss/gain in obesity through modifying obesity-induced inflammatory stress. Specifically, we will determine the extent to which obesity is associated with elevated levels of pro-inflammatory cytokines known to promote bone resorption, determine how obesity affects functions of bone cells and bone metabolism, determine the extent to which existing chronic inflammatory stress (induced experimentally by lipopolysaccharide implantation), estrogen deficiency (affected by ovariectomy), and subclinical magnesium intake impair bone health in obese animal models and in obese human subjects, and determine how moderate physical activity preserves bone structure as compared to caloric restriction during weight reduction in an obese animal model.

1b. Approach (from AD-416):

Studies will utilize cell culture, animal models and human subjects. We will use diet-induced obese mice or rats to determine the mechanisms by which adiposity interacts with other dietary, hormonal and physiological factors, such as estrogen deficiency, chronic inflammation, magnesium intake, and moderate exercise, and affects bone structure and functions of osteoblasts and osteoclasts. Human studies will use the in-house Community Studies Unit and the Metabolic Research Unit to conduct supplementation and controlled feeding experiments, respectively. We will determine whether 300 mg/d Mg supplementation to obese postmenopausal women with suspected marginal magnesium deficiency, ameliorates pro-inflammatory cytokine production and improves biomarkers of bone resorption and formation balance.

2. Milestones for FY2012:

1. Report animal study on obesity, OVX and bone loss
   Milestone Fully Met

2. Finish sample analysis and report results of the study on LPS implantation effects on inflammatory changes and bone structure
   Milestone Substantially Met

3. Complete experiment determining the effect of combined marginal Mg deficiency and estrogen deficiency on inflammatory stress of obesity; Report results.
   Milestone Substantially Met

4. Complete Mg supplementation of obese postmenopausal women study; conduct laboratory analyses of planned endpoints

Project Number: 5450-51000-046-00D **Accession:** 0419343 **FY:** 2012

Milestone Not Met
Critical vacany (quantitative or qualitative deficiency in personnel
The SY has retired and the vacancy has not been filled

5. Conduct animal study on calorie restriction and exercise on bone metabolism and finish sample analyses
Milestone Substantially Met

3. **Progress Report:**
An animal study was conducted to determine whether obesity exacerbates the bone loss induced by chronic inflammation. Forty-eight female C57BL/6J mice aged 6-wk-old were randomly assigned to four groups in a 2 x 2 factorial design: control or 1.5 µg/d lipopolysaccharide (LPS) and fed either normal-fat control diet or a high-fat diet. LPS was used to stimulate an inflammatory response. Animals were implanted a slow release LPS or a placebo pellet subcutaneously in the dorsal region of the neck. Data have been collected and are prepared for publication.
A human study was completed to determine optimal protein intake and musculoskeletal response to energy deficit. Thirty-nine physically active volunteers aged 18 - 42 were recruited to participate in a 31-d live-in, controlled feeding study. Subjects were randomly assigned to three dietary groups: high protein (2.4 g/kg/d), moderate protein (1.6 g/kg/d), or low protein (0.8 g/kg/d). Using stable isotope methodology, muscle biopsies, and various molecular techniques, direct measures of muscle protein synthesis, protein breakdown, and the cellular mechanisms that regulate these processes were assessed following energy sufficient and insufficient diets. Markers of bone turnover and calcium homeostasis were also assessed. Data are currently being analyzed and summarized for publication.
An experiment was completed to determine whether magnesium deficiency enhances or magnesium supplementation alleviates chronic inflammation and bone loss in obese and estrogen-deficient female rats. Female rats aged 65-75 days were assigned to dietary treatments of 50%, 100%, and 150% of the magnesium requirement and increased fat was supplied by high-oleic acid sunflower oil. Data are currently being analyzed and summarized for publication.

4. **Accomplishments**

01 Alpha-1 antitrypsin reduces ovariectomy-induced bone loss. Increased production of cytokines causes inflammation and induces bone loss in postmenopausal women. ARS scientists at Grand Forks, ND investigated whether an anti-inflammatory agent, alpha-antitrypsin, protects estrogen deficient mice (a postmenopausal model) from bone loss Estrogen deficiency resulted in significant bone loss, but mice treated with alpha-1 antitrypsin injection had increased bone mass and thickness compared to mice not treated with alpha-1-antitrypsin. These animal results provide insights for potentially using anti-inflammation agents as a tool to reduce bone loss in postmenopausal women.

107	2	A	2009
107	3	A	2009

02 High-protein diet preserves skeletal muscle mass and has no harmful effect on calcium balance during sustained energy shortage. Energy deficiency induces weight loss whic may have negative effects on the muscle-bone system. Dietary protein intake in excess of the current national dietary recommendation may offer protection against these negative effects. ARS scientists at Grand Forks, ND, conducted a 31-d live-in, controlled feeding study to measure dietary calcium absorption, muscle protein synthesis, protein breakdown, and cellular mechanisms that regulate these processes. The data demonstrated that consumption of a high protein diet conserved muscle mass and promoted the loss of fat during sustained energy deficit. High protein diets have

Project Number: 5450-51000-046-00D **Accession:** 0419343 **FY:** 2012

no negative effect on Ca absorption and Ca excretion. The results from this human study provide evidence useful for developing dietary strategies for protein intake tc maintain healthy muscle and bones during energy deficit and weight loss.

107 2 A 2009
107 3 A 2009

5. Significant Activities that Support Special Target Populations:

6. Technology Transfer:

0 **Number of New CRADAs**
0 **Number of Active CRADAs**
0 **Number of New MTAs (providing only)**
0 **Number of Invention Disclosures Submitted**
0 **Number of Patent Applications Filed**
0 **Number of New Germplasm Releases**
0 **Number of new commercial licenses granted**
0 **Number of web sites managed**
0 **Number of non-peer reviewed presentations and proceedings**
0 **Number of newspaper articles and other presentations for non-science audiences**
5 **Number of Other Technology**

Other Technology Details:

01 **Description:** Dietary Protein and Calcium Absorption. Brown University, Providence, RI. January 10, 2012
Transfer: Information about how dietary protein affects Ca absorption and bone health in humans
Customer/user: Scientists and research staff at the University
Impact/outcome: Information on protein intake can be used as a dietary guideline to promote bone health.

02 **Description:** Alpha-1 antitrypsin reduces ovariectomy-induced bone loss in mice, Experimental Biology 2012, Washington, DC, April 23, 2012.
Transfer: Information about how alpha-1 antitrypsin could reduce inflammation and reduce bone loss due to estrogen deficiency.
Customer/user: Scientists and nutritionists
Impact/outcome: Information provided may be used to establish dietary guidelines that will help prevent diseases associated with obesity and chronic inflammatory stress, including osteoporosis.

03 **Description:** Plasma magnesium, magnesium balance, and dietary magnesium as indicators of magnesium status of individuals in metabolic unit and community studies, Center for Drug Evaluation and Research, FDA, Silver Spring, MD, October 12, 2011.
Transfer: Information about how to assess magnesium status in humans.

Project Number: 5450-51000-046-00D **Accession:** 0419343 **FY:** 2012

Customer/user: Scientists and nutritionists
Impact/outcome: Information provided may be used to establish dietary guidelines that will help prevent diseases associated with marginal magnesium deficiency.

04 **Description:** History of zinc in agriculture, Experimental Biology 2012, Washington, DC, April 22, 2012.
Transfer: Information about how zinc affects health.
Customer/User: Scientists, Physicians, Health care providers, Nutritionists
Impact/outcome: Information may be used by health professionals providing dietary advice and counseling that promotes health.

05 **Description:** Increased adiposity induced by high dietary butter oil increases vertebrae trabecular structural indices in rats, Experimental Biology 2012, Washington, DC, April 23, 2012.
Transfer: Information about how high dietary fat affects bone structure in animal model.
Customer/User: Scientists and Nutritionists
Impact/outcome: Information may be used to establish dietary guidelines that will help prevent obesity-related diseases.

7. **International Cooperation / Collaboration**

Scientific Publications: **Log 115**

1. Tang, H., Yan, C., Cao, J.J., Sarma, J.V., Haura, E.B., Wu, M., Gao, H. 2011. An essential role for the Stat3 in regulating IgG immune complex-induced pulmonary inflammation. Journal of Federation of American Societies for Experimental Biology. 25:4292-4300. **000027645**
2. Cao, J.J., Gregoire, B.R., Zeng, H. 2012. Selenium deficiency decreases antioxidative capacity and is detrimental to bone microarchitecture in mice. Journal of Nutrition. 142:1526-1531. **000027204**
3. Shen, C., Yeh, J.K., Cao, J.J., Chyu, M., Wang, J. 2012. Green tea and bone health. Pharmacological Research. 64(2):155-161. **000026344**
4. Shen, C., Samathanam, C., Tatum, O.L., Graham, S., Tubb, C., Cao, J.J., Dunn, D.M., Wang, J. 2011. Green tea polyphenols avert chronic inflammation-induced myocardial fibrosis of female rats. Inflammation Research. DOI:10.1007/s0001 - 011 -0320-y. **000026325**
5. Cao, J.J., Gregoire, B.R., Song, S. 2012. Alpha-1 antitrypsin reduces ovariectomy-induced bone loss in mice. Annals of the New York Academy of Sciences. doi: 10.111/j.1749-6632.2011.06370.x. **000027773**
6. Shen, C., Yeh, J.K., Samathanam, C.A., Cao, J.J., Stoecker, B.J., Dagda, R.Y., Chyu, M., Wang, J. 2011. Protective actions of green tea polyphenols and alfacalcidol on bone microstructure in female rats with chronic inflammation. Journal of Nutritional Biochemistry. 22(7):673-680. **000025094**

Approved: MCGUIRE MICHAEL R **Date:** 09/27/2012

Project Number: 5450-51000-048-00D **Accession:** 0419645 **FY:** 2012

ModeCode: 5450-20-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
DIETARY PREVENTION OF OBESITY-RELATED DISEASE RESEARCH

NPL Leader: JOHN W FINLEY **Prin Invs:** MATTHEW J PICKLO

Start Date: 05/27/2010 **Term Date:** 09/30/2014

National Programs: 107 N Human Nutrition

Title: FOOD FACTORS AND MAINTENANCE OF BODY WEIGHT AND HEALTH

Period Covered **From:** 10/2011 **To:** 9 /2012 **Final Report?** No
Terminate in Two Months? No

Progress and Outcomes:

1a. Objectives (from AD-416):

1. Determine the extent to which dietary antioxidants alter obesity-induced and/or exercise-induced changes in mitochondrial function and insulin sensitivity.
Sub-objective 1A. Determine the influence of anti-oxidant supplementation on changes in insulin sensitivity induced in the rat by high dietary fat and exercise.
Sub-objective 1B. Determine the degree to which anti-oxidant supplementation alters exercise-induced changes in insulin sensitivity and mitochondrial function responses of overweight/obese individuals.
2. Identify sites and causes of obesity-induced and exercise-induced oxidative stress.
Sub-objective 2A. Determine the effects of obesity and exercise on the temporal and cellular activation of the nuclear factor (erythroid-derived 2)-like 2 (Nrf-2)/Anti-oxidant Response Element pathway.
Sub-objective 2B. Identify and characterize obesity-induced and exercise-induced oxidative changes to insulin signaling pathway proteins.
3. Identify, characterize and compare sites of obesity-induced versus exercise-induced mitochondrial respiratory changes.
Sub-objective 3A. Determine the degree to which anti-oxidant supplementation blunts exercised-induced and obesity-induced changes in mitochondria.

1b. Approach (from AD-416):

In order to complete the objectives of this proposal, we will utilize a combination of studies in humans, rodents that examine physiologic, metabolomic, genetic, and proteomic endpoints. In Objective 1, we will perform studies in humans and rodents to determine how antioxidant (vitamin E and vitamin C) supplementation affects insulin responses to exercise and obesity. The study in humans will involve analysis of exercise adaptation and insulin responses in previously untrained individuals and if antioxidant supplementation either enhances or negates these adaptations. Rodent studies will further examine molecular mechanisms underlying these adaptations.
In Objective 2, we will determine the extent to which obesity, exercise, and anti-oxidant supplementation alter redox balance in animals and specific cells and to identify specific proteins whose thiol redox status is altered in obesity, exercise, and anti-oxidant supplementation. These studies will utilize transgenic mouse models and proteomic approaches.
In Objective 3, we will determine the extent to which obesity, exercise, and anti-oxidant supplementation alter mitochondrial function. These studies will utilize rat models of exercise and obesity. Whole tissue and isolated mitochondria will be studied for changes in total mitochondrial content, mitochondrial gene expression, and respiration, and mitochondrial enzyme activities.

Project Number: 5450-51000-048-00D **Accession:** 0419645 **FY:** 2012

2. **Milestones for FY2012:**

1. We will perform initial experiments to determine exercise parameters, perform anti-oxidant supplementation studies in obese and exercising rats, and perform glucose, insulin, fatty acid analyses.
Milestone Substantially Met

2. We will perform analyses for redox status and insulin signaling proteins and write/submit manuscripts for publication.
Milestone Substantially Met

3. We will perform studies on 18 subjects and process samples.
Milestone Not Met
Insufficient resources (lack of operational funds)

4. We will perform experiments on obese and exercising ARE/hPAP mice, determine the activity and localization of ARE/hPAP transgene in these conditions, analyze data, and write/submit manuscripts for publication.
Milestone Substantially Met

5. We will determine oxidative modifications of recombinant PTEN and PTP1B.
Milestone Not Met
Insufficient resources (lack of operational funds)

6. Determine the degree to which anti-oxidant supplementation blunts exercised-induced and obesity-induced changes in mitochondria
Milestone Substantially Met

3. **Progress Report:**
During FY 2012, the project team made progress in multiple areas.

Objective 1A. We performed studies in rats testing the hypothesis that vitamin C and vitamin E supplementation prevents glucose intolerance in obese rats. We are currently analyzing the samples and data. We will test the hypothesis that vitamin C and vitamin E supplementation prevents exercise adaptations in rats in the FY 2013. This work will examine the role of anti-oxidant supplements as adjuncts to treatment of obesity or enhancing the effects of exercise.

Objective 1B. This study investigates whether anti-oxidant supplementation (vitamins C and E) modulate exercise responses particularly with respect to blood sugar regulation in overweight/obese people. Unfortunately, the scientist overseeing this study left the GFHNRC. Over 6 months of recruiting, we had poor response. It was decided to halt recruitment and the study.

Objective 2A. This objective tests the hypothesis that exercise and nutritional factors regulate cellular redox status in tissue specific ways. To test this hypothesis, we developed a colony of Anti-oxidant Reporter Element (ARE)-reporter mice. We were able to see induction of this pathway in liver through feeding the mice butylated hydroxyanisole (BHA), a known ARE inducer. However, whether with forced or voluntary exercise, we were unable to demonstrate changes in ARE pathways in liver or skeletal muscle. Owing to the poor results with this mouse model, we decided not to pursue these experiments further in this model.

Demonstrated that adipocyte differentiation reduces protein levels of the ARE-dependent protein NQO1. We demonstrated that the dietary component sulforaphane blocks adipocytes

Project Number: 5450-51000-048-00D **Accession:** 0419645 **FY:** 2012

hypertrophy in part through induction of NQO1. This work is currently in press - Free Radical Biology and Medicine.

Objective 2B. The hypothesis of this work is that lack of exercise and obesity induces a hyper-reductive state of insulin signaling proteins. We developed methods for determining changes in protein redox state and demonstrated that glutathione modification of proteins was decreased in visceral adipose and liver of obese rats. This work was accepted for publication in the journal Obesity.

Objective 3. We performed exercise studies in mice (voluntary) and rats (forced running wheel). Analysis of mitochondria DNA and mitochondrial respiratory proteins in skeletal muscle did not demonstrate a difference between sedentary and exercised animals.

This research project includes an ancillary project examining the role of Atlantic salmon consumption as a means to increase omega 3 fatty acids in humans. This project is a collaboration with the ARS-National Cold Water Aquaculture Center in Franklin, ME. We published one paper demonstrating that baking salmon decreases the presence of fatty acid oxidation products and does not decrease the content of beneficial omega-3 fatty acids in salmon - Journal of Agricultural and Food Chemistry. We have submitted one paper demonstrating that eating baked salmon increases blood omega-3's in a dose-dependent manner.

4. Accomplishments

01 Obesity regulates protein modification in visceral adipose and liver. This work studied how obesity alters oxidative damage to proteins. This work focused on protein oxidation in liver, muscle, and visceral adipose - tissues that contribute to insulin resistance in obesity. Data generated by ARS scientists at Grand Forks, ND demonstrat that a specific type of protein modification - glutathionylation-is actually reduced by induction of obesity. These results indicate that protein changes in obesity are more complex than originally thought and provide insight into how oxidative stress an protein function are modulated in obesity. Because of the study the effects of anti-oxidant supplements upon protein damage in obesity will be investigated.

107 3 A 2009

02 Fat cell growth and antioxidants. During fat cell growth levels of anti-oxidant proteins are reduced, but the protein levels can be maintained by the dietary component sulforophane. ARS scientists at Grand Forks, ND determined that dietary sulforaphane blocks adipocyte development in part by inducing the production of NQO1, an anti-oxidant protein. The results provide insight into how oxidative stress is modulated in obesity and that how diet components may reduce obesity.

107 2 A 2009

03 Farmed salmon consumption increases plasma levels of n3 fatty acids in humans. Two servings of oily fish per week are recommended to prevent heart disease by increasing levels of n3 fatty acids in humans. However there were no studies showing the effect of eating this level of fish upon n3 fatty acids in people. ARS scientists at Grand Forks, ND showed that consumption of 4 ozs of farmed Atlantic salmon twice per week significantly increased n3 fatty acids. This work has impact for consumers, health professionals, and for producers of farmed salmon.

107 2 A 2009

5. Significant Activities that Support Special Target Populations:

Project Number: 5450-51000-048-00D Accession: 0419645 FY: 2012

6. Technology Transfer:

0 Number of New CRADAs
0 Number of Active CRADAs
0 Number of New MTAs (providing only)
0 Number of Invention Disclosures Submitted
0 Number of Patent Applications Filed
0 Number of New Germplasm Releases
0 Number of new commercial licenses granted
0 Number of web sites managed
0 Number of non-peer reviewed presentations and proceedings
0 Number of newspaper articles and other presentations for non-science audiences
10 Number of Other Technology

Other Technology Details:

01 **Description:** Newspaper article

Picklo MJ. "OMG-Omega 3s!" Grand Forks Herald, Grand Forks, ND. May 2012.
Customer/user: General lay population of Grand Forks, ND area
Impact/outcome: Inform and educate general public about the health benefits of eating foods high in omega-3 fatty acids.

02 **Description:** Presentation for International society meeting

Vomhof-DeKrey E. and Picklo MJ. Lack of Nrf2 reduces voluntary exercise in mice: influences of sex and diet. Society for Free Radical Biology and Medicine. Atlanta, GA. November 2011.
Customer/user: Scientists, health professionals, nutritionists.
Impact/outcome: Demonstrated that the Nrf2 transcription factor regulates exercise capacity in male but not female mice. Indicates that anti-oxidant pathways also affect energy metabolism pathways.

03 **Description:** Presentation for International society meeting

Nrf2 pathway proteins are differentially expressed during 3T3-L1 adipocyte differentiation. Society for Free Radical Biology and Medicine. Atlanta, GA. November 2011.
Customer/user: Scientists, health professionals, nutritionists.
Impact/outcome: Demonstrated that specific anti-oxidant enzyme pathways are reduced during adipocyte hypertrophy.

04 **Description:** Presentation for International society meeting

Picklo MJ, Jackson MI, Idso JP. Glutathionylation of Hepatic and Visceral Adipose Proteins Decreases in Obese-Prone, Glucose Intolerant Rats. Society for Free Radical Biology and Medicine. Atlanta, GA. November 2011.
Customer/user: Scientists, health professionals, nutritionists.
Impact/outcome: Demonstrated that the level of reversible protein modification by glutathione is reduced by obesity in liver and visceral

Project Number: 5450-51000-048-00D **Accession:** 0419645 **FY:** 2012

adipose.

05 **Description:** Presentation for International society meeting

Picklo MJ, Idso JP, Jackson MI, N-methyl-2-vinylpyridinium ion as a thiol alkylator for thiol proteomics. Society for Free Radical Biology and Medicine. Atlanta, GA. November 2011.
Customer/user: Scientists, health professionals, nutritionists.
Impact/outcome: Identified and characterized a novel compound for proteomics work.

06 **Description:** Presentation for International society meeting

Picklo M, Rosenberger T, Burr G, Wolter W, Raatz S. Twice-weekly consumption of farmed Atlantic salmon increases plasma content of phospholipid n-3 fatty acids. American Society for Nutrition/Experimental Biology, San Diego, CA, April 2012.
Customer/user: Scientists, health professionals, nutritionists.
Impact/outcome: Demonstrated that eating even a 4 oz portion of farm-raised salmon effectively raises omega-3 fatty acid in the blood.

07 **Description:** Symposium co-chair " Adipose Dysfunction: Interaction of ROS and Inflammation" at the April 2012 Experimental Biology (EB) meeting in San Diego, California.

Customer/user: Scientists, health professionals, nutritionists.
Impact/outcome: Co-chaired a symposium that brought together world experts on obesity and adipose tissue dysfunction. Over 300 attendees learned about cutting edge science regarding the interactions of inflammation and oxidative stress in adipose tissue during obesity.

08 **Description:** Taught two lectures on Spectroscopy and Chromatography, University of North Dakota, September 2011

Customer/user: Graduate Students
Impact/outcome: Taught graduate level science students principles of light spectroscopy and chromatography.

09 **Description:** Planned and directed GFHNRC booth at 2012 Health Care Expo, Grand Forks North Dakota. Organized talks and demonstrations by Center scientists. Over 2000 attendees
Customer/user: General lay population of Grand Forks, ND area
Impact/outcome: Promoted healthy nutrition guidelines for community; enhanced visibility of the GFHNRC, assisted with recruiting volunteers for nutrition studies.

10 **Description:** Presentation of work within Research Unit at United States Army Institute for Environmental Medicine, Natick, MA. January, 2012
Customer/user: Scientists, Nutritionists
Impact/outcome: Forged subsequent collaborations with Department of Defense scientists to identify novel nutritional modalities for soldiers in training and in the field.

Project Number: 5450-51000-048-00D **Accession:** 0419645 **FY:** 2012

7. International Cooperation / Collaboration

Scientific Publications: Log 115

1. Uthus, E.O., Picklo, M.J. 2011. Obesity reduces methionine sulfoxide reductase activity in visceral adipose tissue. Free Radical Research. 45(9):1052-1060. 000026427
2. Raatz, S.K., Young, L.R., Picklo, M.J., Sauter, E.R., Qin, W., Kurzer, M.S. 2012. Total dietary fat and fatty acid content modify plasma phospholipid fatty acids, desaturase activity indices and urinary prostaglandin E. Nutrition Research. 32:1-7. 000026964
3. Raatz, S.K., Golovko, M.Y., Brose, S.A., Rosenberger, T.A., Burr, G.S., Wolters, W.R., Picklo, M.J. 2011. Baking reduces prostaglandin, resolvin, and hydroxy-fatty acid content of farm-raised Atlantic salmon (Salmo salar). Journal of Agricultural and Food Chemistry. 59:11278-11286. 000026965
4. Dekrey, E.E., Picklo, M.J. 2012. The Nrf2-antioxidant response element pathway- a target for regulating energy metabolism. Journal of Nutritional Biochemistry. doi:10.1016/j.jnutbio.2012.03.005. 000027707
5. Dekrey, E.E., Picklo, M.J. 2012. NAD(P)H:quinone oxidoreductase 1 activity reduces hypertrophy in 3T3-L1 adipocytes. Free Radicals in Biology and Medicine. 53:(2012)690-700. 000027169
6. Picklo, M.J., Azenkang, A., Hoffman, M. 2011. Trans-4-oxo-2--nonenal potently alters mitochondrial function. Free Radical Biology and Medicine. 50(2):400-407. 000025787

Approved: MCGUIRE MICHAEL R **Date:** 09/27/2012

Project Number: 5450-51000-048-01N **Accession:** 0420147 **FY:** 2012

ModeCode: 5450-20-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
DIETARY PREVENTION OF OBESITY-RELATED DISEASE RESEARCH

NPL Leader: MARY J KRETSCH **Prin Invs:** GERALD F COMBS

Start Date: 09/01/2010 **Term Date:** 08/31/2015

National Programs: 107 N Human Nutrition

Title: HEALTHY BODY WEIGHT RESEARCH

Period Covered **From:** 10/2011 **To:** 9 /2012 **Final Report?** No
Terminate in Two Months? No

Agreement Number: 58-5450-0-0111N

Organization Name: US ARMY RES INST ENVIR MEDICINE

Progress and Outcomes:

1a. **Objectives (from AD-416):**

Collaborate in planning, implementation and reporting of research on the effects of diet and physical activity in maintaining healthy body weight.

1b. **Approach (from AD-416):**

Human volunteers will be studied under a variety of diety conditions and physical activity regimens, and biochemical and functional parameters will be measured.

3. **Progress Report:**

This report documents research conducted under a Non Funded Cooperative Agreement between ARS and the US ARMY RESEARCH INSTITUTE FOR ENVIRONMENTAL MEDICINE. Additional details for the research can be found in the report for the parent project 5450-51000-048-00D, FOOD FACTORS AND MAINTENANCE OF BODY WEIGHT AND HEALTH

Studies were conducted to determine the effect of dietary protein level of the status of muscle protein and bone mineral during a 30-day period of negative energy balance. This was done in young men and women volunteers who lived in our metabolic unit and were subjected to a 30% energy deficit by dietary means with a 10% increase in energy output by prescribed physical activity. Bone mineral was evaluated by the retention of an infuse dose of stable calcium; protein accretion was determined by the uptake of an infused dose of stable isotopically labeled amino acids into samples of thigh muscle collected by biopsy. The active experimental phase of this study was completed in FY2012; samples are being analyzed. Preliminary results show that moderately increased protein intake can reduce the loss of muscle protein that occurs under conditions of negative caloric balance in exercising men and women.

ARS PI monitoring activities to evaluate research progress included: phone calls/conference calls, site visits, email communications, discussions at professional conferences/meetings, review of Accomplishment Report.

Approved: CHANDLER LAURENCE D **Date:** 09/24/2012

Project Number: 5450-51000-048-02S **Accession:** 0420151 **FY:** 2012

ModeCode: 5450-20-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
DIETARY PREVENTION OF OBESITY-RELATED DISEASE RESEARCH

NPL Leader: JOHN W FINLEY **Prin Invs:** GERALD F COMBS

Start Date: 09/01/2010 **Term Date:** 08/31/2015

National Programs: 107 N Human Nutrition

Title: CLINICAL RESEARCH

Period Covered **From:** 10 / 2011 **To:** 9 / 2012 **Final Report?** No
Terminate in Two Months? No

Agreement Number: 58-5450-0-0342

Organization Name: UNIVERSITY OF NORTH DAKOTA

Progress and Outcomes:

1a. **Objectives (from AD-416):**

This project will benefit the people of the United States by facilitating the production of new knowledge that will significantly improve the evidence base for national food, nutrition and health policies. It will bring together two entities, the USDA-ARS and the University of North Dakota, as represented by the School of Medicine and Health Sciences (UND-SMHS), each with strong scientific and technical capabilities, to produce a combined effort that is unique in its ability to design and conduct human clinical intervention trials addressing the knowledge gaps critical to reversing the national epidemic of obesity and its co-morbidities. This partnering advances the mission of the Grand Forks Human Nutrition Research Center (GFHNRC) in regard to its conducting research with human subjects.

1b. **Approach (from AD-416):**

Partnering with the UND-SMHS will enhance the research mission of the USDA-ARS GFHNRC in the areas of clinical research in human nutrition, metabolism, and physiology. The UND-SMHS will bring necessary expertise in medicine and human health surveillance. Health oversight by UND-SMHS licensed physicians will be a valuable contribution provided for conducting human nutrition research. The combined effort will produce synergy resulting in a unique capability for conducting human clinical trials addressing the prevention of obesity. Those trials will address the following areas:
1. Sustainability of diet/physical activity practices consistent with the Dietary Guidelines for Americans.
2. Roles of diet and physical activity in mitigating obesity-related diseases, diabetes, cancer and bone loss.
These clinical trials will be among the first designed to test the Dietary Guidelines for Americans in a healthy population. This research will support further enhancement of the dietary guidelines as well as related national policies concerning food, nutrition and health.

3. **Progress Report:**
This report documents research conducted under a Specific Cooperative Agreement between ARS and the UNIVERSITY OF NORTH DAKOTA. Additional details for the research can be found in the report for the parent project 5450-51000-048-00D, FOOD FACTORS AND MAINTENANCE OF BODY WEIGHT AND HEALTH
This project provided clinical research support for several human studies protocols in

Project Number: 5450-51000-048-02S **Accession:** 0420151 **FY:** 2012

FY2012. These included a study of the effect of dietary protein on muscle protein and bone mineral retention during negative energy balance in which this project provided the expertise for performing muscle biopsies. This project also provided the health surveillance oversight for that and 9 other active human protocols.

ARS PI monitoring activities to evaluate research progress included: phone calls/conference calls, email communications, review of Accomplishment Report.

Approved: CHANDLER LAURENCE D **Date:** 09/24/2012

Project Number: 5450-51000-048-04S **Accession:** 0421840 **FY:** 2012

ModeCode: 5450-20-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
DIETARY PREVENTION OF OBESITY-RELATED DISEASE RESEARCH

NPL Leader: JOHN W FINLEY **Prin Invs:** MATTHEW J PICKLO

Start Date: 08/01/2011 **Term Date:** 07/31/2013

National Programs: 107 N Human Nutrition

Title: EVALUATE THE NUTRITIONAL ADEQUACY AND EFFECTS OF DIETARY FATS AND LIPIDS

Period Covered **From:** 10 / 2011 **To:** 9 / 2012 **Final Report?** No
Terminate in Two Months? No

Agreement Number: 58-5450-1-0345

Organization Name: UNIVERSITY OF NORTH DAKOTA

Progress and Outcomes:

1a. **Objectives (from AD-416):**

To determine how salmon consumption alters lipid oxidation parameters in human plasma. In this work, we will quantify the content of omega-6 and omega-3 fatty acids in the plasma from participants in the GFHNRC human study that have consumed differing amounts of salmon as a source of omega-3 fatty acids. These data will provide information on the role of fish consumption upon markers of inflammation and oxidative stress. Attainment of this data may be useful in future deliberations of the dietary guidelines committee on the evidence base for long chain omega-3 fatty acid recommended intake levels.

1b. **Approach (from AD-416):**

The GFHNRC will perform the necessary salmon feeding trial and collection of plasma samples. Samples of plasma will be delivered to the cooperator for analysis of fatty acid oxidation products. The cooperator will also offer expertise in interpretation and writing of the results. Data will be presented and published with GFHNRC scientists and the cooperator as authors. The cooperator will also offer expertise in interpretation of the results of the phospholipid fatty acids.

3. **Progress Report:**

This report documents research conducted under a Specific Cooperative Agreement between ARS and the UNIVERSITY OF NORTH DAKOTA. Additional details for the research can be found in the report for the parent project 5450-51000-048-00D, FOOD FACTORS AND MAINTENANCE OF BODY WEIGHT AND HEALTH

During the past year, the GFHNRC completed the necessary salmon feeding trial in people and collection of plasma samples. The cooperator analyzed the plasma for content of fatty acids in the plasma phospholipids. The cooperator offered expertise in interpretation and writing of the results. Data were presented at the Experimental Biology meeting April 2012. The results are currently under submission with GFHNRC scientists and the cooperator as authors.

ARS PI monitoring activities to evaluate research progress included: phone calls/conference calls, email communications, discussions at professional conferences/meetings, review of Accomplishment Report.

Project Number: 5450-51000-048-04S **Accession:** 0421840 **FY:** 2012

Approved: CHANDLER LAURENCE D **Date:** 10/22/2012

FINAL PROGRESS REPORTS

OF

TERMINATED CRIS WORK UNITS

Project Number: 5450-51000-049-08S **Accession:** 0421807 **FY:** 2012

ModeCode: 5450-10-00 NORTHERN PLAINS AREA
GRAND FORKS HUMAN NUTRITION RESEARCH CENTER (GRAND FORKS, ND)
HEALTHY BODY WEIGHT RESEARCH

NPL Leader: JOHN W FINLEY **Prin Invs:** GERALD F COMBS

Start Date: 09/01/2011 **Term Date:** 08/31/2013

National Programs: 107 N Human Nutrition

Title: IMPROVE COMMUNITY HEALTH THROUGH NUTRITION AND LIFESTYLE RESEARCH

Period Covered **From:** 10/2011 **To:** 9 /2012 **Final Report?** Yes
Terminate in Two Months? Yes

Agreement Number: 58-5450-1-0339

Organization Name: CANKDESKA CIKANA COMM COLLEGE

Progress and Outcomes:

1a. **Objectives (from AD-416):**

To develop information useful in promoting health through improved nutrition and lifestyles. Specifically: (1) Develop understanding of the relationships of diet, lifestyle and the prevalence of chronic diseases, particularly obesity, diabetes, and cardiovascular disease in American Indian peoples; and (2) Increase research cooperation between American Indian colleges and the USDA-ARS.

1b. **Approach (from AD-416):**

Identification and characterization of barriers to and facilitators of eating healthy diets and engaging in healthy lifestyles will be accomplished through a series of focus groups in American Indian communities. Focus groups will be conducted with appropriate review and approval by the respective institutional review boards used by Cankdeska Cikana Community College and ARS.

3. **Progress Report:**

This report documents research conducted under a Specific Cooperative Agreement between ARS and the CANKDESKA CIKANA COMMUNITY COLLEGE. Additional details for the research can be found in the report for the parent project 5450-51000-049-00D, DIETARY GUIDELINES ADHERENCE AND HEALTHY BODY WEIGHT MAINTENANCE

Work was completed in evaluating data obtained from structured focus groups on the Spirit Lake Lakota Nation on the subject of barriers and facilitators of following the Dietary Guidelines. A final manuscript is in preparation.

ARS PI monitoring activities to evaluate research progress included: phone calls/conference calls, site visits, email communications, review of Accomplishment Report.

Approved: CHANDLER LAURENCE D **Date:** 10/24/2012